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CHARLES FELTON SCOTT AWARDED THE THIRD LAMME MEDAL

Charles Felton Scott, Professor of Electrical Engineering, Yale University, was awarded the third Lamme medal by the Society for the Promotion of Engineering Education at its thirty-eighth annual meeting at Montreal, June 26–28, 1930.

Charles Felton Scott was born at Athens, Ohio, in 1864. After graduating from Ohio State University, of which his father was President, in 1885, he took graduate work at Johns Hopkins University and, at the same time, taught in the Baltimore and Ohio Railroad Technological School. Professor Scott also received the degree of A.M. from Yale, Sc.D. from the University of Pittsburgh, and Eng. D. from Stevens Institute of Technology.

In 1888 Professor Scott entered the employ of the Westinghouse Electric and Manufacturing Company, starting in the Testing Department. In 1891, he became Assistant Electrician and in 1897, Chief Electrician. In 1904, he became consulting engineer to the Company, a position which he still holds. In 1911, he accepted the Professorship of Electrical Engineering at Yale.

While with the Westinghouse Company, Charles F. Scott was suggested as the man best fitted to assist Nikola Tesla in his world-renowned work on alternating currents. His early experience in the Company brought him in close contact and coöperation with Benjamin Garver Lamme, by whom the Lamme Award was established. Professor Scott's early interest in educational development led to the establishment of the Westinghouse Club. Thousands of student engineers have benefited by the facilities of the Club, and many more thousands have been aided in their advancement by the engineering data and inspiration furnished by reading the pages of the *Electrical Journal*, "The Magazine of the Young Engineer," which he also founded.

While his international reputation began with his invention of the "Scott connection" of transformers, there is scarcely any field, no matter how small, which forms a part of the general science or the profession of electrical engineering in which Professor Scott has not made some worth-while contribution, in recognition of which, in the past year, he was awarded the Edison Medal by the American Institute of Electrical Engineers.

His foresight, while President of the American Institute of Electrical Engineers, led to the development of sections and the estab-

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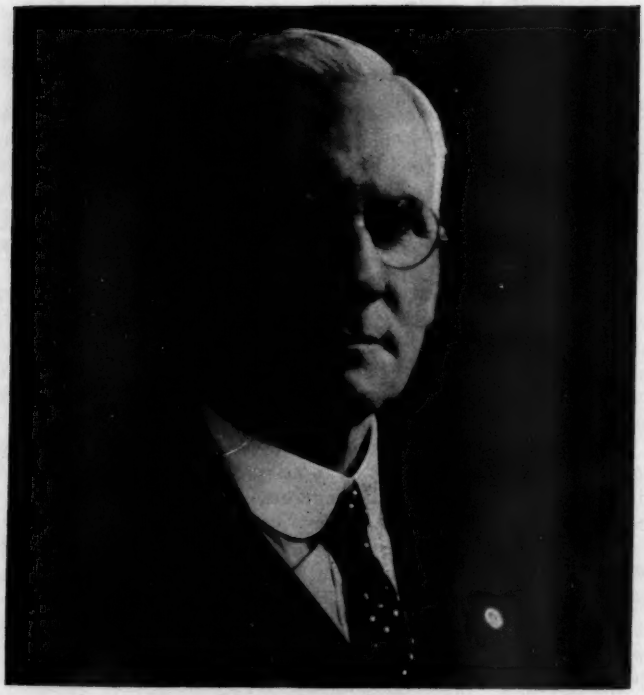

CHARLES FELTON SCOTT

Recipient, Third Lamme Medal, Society for the Promotion of Engineering Education, June 27, 1930

lishment of student branches. He had the vision which culminated in the erection of the Engineering Societies building and the Engineers' Club in New York, carrying on the negotiations with Andrew Carnegie. He was Chairman of the Building Committee. He was instrumental in forming the Federated American Engineering Society, and is a member of its governing body, the American Engineering Council. In 1921 he was elected President of this Society, and his work, that year, led to his re-election in 1922. No man before him or since ever held that office more than one year.

Professor Scott's vision of broadening and enriching engineering education led to the investigation of that subject by this Society. He has been Chairman of the Board of Investigation and Coördination which directed that project. He secured the necessary funds for this work—both for the initial investigation and later for the further study of the subject. He has worked untiringly and unselfishly for the promotion of engineering education.

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A FEW REFLECTIONS

By HAROLD S. BOARDMAN

President of the Society

Does the present day educator take himself too seriously? In this day of intense endeavor to develop the best ways of doing things and of following the slogan "efficiency" are we losing our perspective and letting the present and our ideas of the future overshadow the past? In our desire to become educated ourselves, are we worshipping research and the Ph.D. degree and allowing only the overflow to reach the undergraduate student? Are we using human material to experiment upon in our laboratories of life in an attempt to put our pet theories of education into practice? Are we riding a hobby when we make mathematical deductions by use of personnel systems, intelligence tests, placement examinations, et cetera, and say to this student thou shalt and to that student thou shalt not?

These are only a few of the questions that crowd my mind more and more as the years pass by, and I wonder at times if after all we are doing our work better or worse than we did twenty-five years ago. The present age of educational experimentation has been pregnant with so much in the way of reports and dissertations upon this and that phase of the subject that one is likely to become lost in his endeavor to arrive at logical conclusions based upon so many premises, many of which are diametrically opposite. It is true that there are different ways of doing things and we may arrive at certain objectives by various routes. There are, however, certain fundamental principles which should be our guide in teaching the young and untrained mind. These principles have stood the test of time and apparently cannot be replaced by substitutes if we would develop the scholar, and I take it that a high type of scholarship nowadays indicates ability in engineering as well as in arts or in the older professional curricula.

To me, one of the most important requirements in teaching is the development of a personal relation between teacher and pupil. There is a certain philosophy of education which must be absorbed by the pupil in order for him to become a real scholar and finally a power in his profession, and much depends upon the attitude of the teacher. It has been said that "Science without philosophy, facts without perspective and evaluation, cannot save us from havoc and

despair. Science gives us knowledge, but only philosophy can give us wisdom." In the ancient days, Socrates taught that there is no real philosophy until the mind turns round and examines itself. And again, "Woe to him who teaches men faster than they can learn." Socrates, Plato, and Aristotle gave to their pupils the best they had and did so by a contact so personal that each pupil could absorb fundamental principles without losing his own identity, and all the while grew in power to think for himself. Can we do better in this enlightened age than to follow some of the methods of those old philosophers whereby real scholars were created?

I fully realize the obstacles in the way of personal contact in this day of mass production, but from my own observation I find that too many of our teachers fail to grasp the student view point with the result that a constantly widening breach is created between student and teacher which has a tendency to develop anything but a spirit of good feeling, without which cooperation is impossible. Too many teachers appear to put their chief efforts upon the development of themselves and use their position as a stepping stone in their upward career, giving their students the benefit of their knowledge in so far as they can with convenience. Too many teachers, having arrived at a position of responsibility, look down from the heights instead of coming down to mingle with the crowd. To be a scholar is a fine thing if it does not, through specialization, narrow the horizon so that one forgets fundamentals and the good things of life and becomes interested only in some phase of his particular field. In fact scholarship in the broad sense is quite necessary for success in any field of scientific endeavor.

I have often wondered if a definition of the term scholar could be given which would fit not only the doctor and the lawyer but the engineer and the candlestick maker as well! Some time ago, I happened upon a definition which seems to apply. "Scholarship is a development of the man who knows and who on the basis of what he knows can think."

I never weary of telling of my ideal of the highest and happiest as well as the most productive type of scholar as expressed by President Hibben of Princeton, in a discourse upon what he called the "Flower and Fruit of Knowledge." He defined the Fruit of Knowledge as the bare results of scholarly investigation, accumulated facts, generalizations, formulae and hypotheses based upon these facts and resulting from the brooding mind. If, however, the effect produced upon the inquiring mind by daily and hourly contact with truth is that of deepening, enriching and refreshing his spirit there is a consequent refinement and elevation of thought and he has acquired the Flower of Knowledge. You and I have known people who have obtained the Fruit of Knowledge, but who have

utterly failed to appreciate what is meant by the Flower of Knowledge. I know that your mind will pick out some teacher who was a special inspiration, and who was the means of creating within you an idealism which has left its mark. Such teachers knew the Flower of Knowledge and in knowing enriched not only their own lives but yours and mine. Such men never grow old. They may run down like a clock that is not wound, but their minds are always young no matter how much of truth they may discover.

ENGINEERING LEADERSHIP *

By R. I. REES

President of the Society for the Promotion of Engineering Education; Assistant Vice President, American Telephone and Telegraph Company, New York City

No one could have attended the impressive ceremonies in commemoration of the 50th anniversary of the American Society of Mechanical Engineers, or listened to the contributions of scientists and engineers from all parts of the world, without being profoundly impressed with the conviction that this is an age of engineering leadership. And out of the inspiration of that great meeting came the engineers' answer to the challenge "Whither Mankind?" Scientists, engineers, engineering teachers have viewed, clear-eyed and unafraid, our present social structure, and have given the straightforward answer, "Toward Civilization."

No one of them, writing of the foundations upon which our present industrial civilization rests, whether it be power, giving each American one hundred slaves to do his bidding; transportation, which has been conquering distance through land, sea, and air; or communication, which has eliminated both time and distance; or architecture, with its new contribution to beauty, has failed to realize that, involved in all of this miraculous technological progress, there is a responsibility for the social consequences of these great developments in engineering leadership.

There is no pause in the progress of science. One would think that engineers and scientists in their climb onward and upward might reach a plateau, rest, and permit the world to catch up with them. But no; only last week at Cornell, Professor A. R. Compton gave us a picture of the interior structure of the atom which he has seen, making clear the nebular haze of electrons surrounding the nucleus with his beautiful analogy of the halo around the moon; and Professor S. Zwicky of the California Institute of Technology told of discoveries concerning the nature of crystal structure which those who know believe may be of great practical benefit in the strengthening of metals and in making possible improved methods of insulation. How gratified Faraday would be to know of the tremendous development of power brought about by his discovery

* Presidential address delivered at the thirty-eighth annual meeting of the S. P. E. E., at Ecole Polytechnique and McGill University, Montreal, Canada, June 26–28, 1930.

of the relations between electricity, magnetism and motion, and of Einstein's near realization of his dream that all manifestations of nature's energy, electricity, magnetism, heat, light, gravitation, are fundamentally the same. Hasn't Dr. Millikan happily symbolized it all as "the sun's fire?"

So the engineer's mastery of energy and material things must go on. He cannot pause nor shirk his responsibility, for through the character of his leadership, he has brought upon himself the responsibility for our present social order. He has brought about our industrial civilization and he must accept leadership which will keep for mankind the benefits which it gives and contribute to the suppression of the evils which have accompanied those benefits.

To insure this steady march of progress towards civilization requires industrial statesmanship of the highest order. While the world cannot demand, nor can the profession furnish, more than a reasonable proportion of executive leadership in industry, yet the engineer's analytical method of thinking and his passion for truth can and will have a great influence on all industrial leadership. Last year Dean Kimball gave courageous and convincing reply to the critics of this technological age. Yet no one knows better than the engineer, the weaknesses of structure in industry and the deterrent influence of these weaknesses on our national progress and prosperity. He knows that the fundamental difficulty in industry today is lack of coördination. The truth of this is best demonstrated by the undoubted success of industries which are well coördinated within themselves and in their relations with others in the same field of production. But what of the lack of coördination in an industry like the textile industry, where a duplication of the New England plants in the South has developed a desperate condition of overproduction which threatens the life of that industry? What can we say of the criminal waste which is going on in the oil industry through lack of coördination? The leaders in that industry are the first among those who deplore the conditions which exist, but they seem helpless to correct them. What sort of condition is it that, when a pool is discovered, permits individual owners, clamorous for their share, to sink twenty to a hundred wells when two or three would suffice. As we know, legal restrictions are largely to blame here for the lack of proper control of production. Industrial statesmanship should attack this problem with government, and fight for early solution if we are to hold our wealth in oil from early exhaustion. Of course, we know that lack of coördination through overproduction is menacing the farmer with ruin. Last week when I was visiting the Summer School of Engineering Teachers at Carnegie Institute of Technology, in conversation with President Baker, he offered this startling but most enlightening suggestion for bring-

ing about the coördination which the coal industry so sadly needs. He stated that the problem can only be solved through intensified scientific and engineering research leading to the extraction of all the products which come out of crude coal and improvement of fuels through technological processes, so that the future will see no further use for the raw product. This will cause a concentrated control of production, and bring about a high degree of coördination in the long-suffering coal industry. These are illustrations of some of the weakest parts of our industrial structure. Many illustrations in smaller fields of endeavor might be included in explaining the frequently heard expression, "Profitless Prosperity." Many of the most efficient in this class are facing annihilation because of cut-throat competition and lack of coördination.

The reason that this is peculiarly a problem within the responsibility of engineering leadership, is that engineers, through the development of technological processes, have solved the production problem. Productive capacity in this country to-day actually exceeds the capacity for consumption. Coördination which will relate supply to demand, is the imperative problem which calls for solution.

The problems of distribution are still far from correct solution. No one can deny that the wide spread between cost at point of production and price to the ultimate consumer is altogether too wide. This problem, of course, involves efficient studies of economy in the whole transportation industry, but it involves more than that in the determination of the points from which distribution should be made. Does there seem to be any reason that San Francisco, or even Chicago, should send steel products to Pittsburgh, and Pittsburgh in turn ship steel products back to these cities? Is there any reason, in a proper scheme of national coördination, why plants for products in major demand should not be so located as to supply a given territory at a minimum cost for distribution? These are questions which the engineer should be preëminently fitted to answer.

Another condition which is crying out for relief is that of unemployment. The engineer, through high leadership in technological fields, can not deny his measure of responsibility for creating this condition. The term "technological unemployment" symbolizes that responsibility. Here is the darkest shadow thrown across the picture of our national prosperity and most obscure are the means of bringing light where that shadow falls. It is another challenge to engineering leadership. I have no solution to suggest and can only raise questions. Can engineers be alert enough when their machines displace workers, to develop new products to tempt the consumer, new processes or new services to absorb the displaced labor? Can this reiterated principle of coördination impell our industries

to act in concert and to devise ways and means to make employment universal and the wage scale adequate? Will the time ever come when no worker will have to seek for a job, but simply ask where it is?

As I said in the beginning, all I can do is to bring before you some of the problems now bearing down upon our industrial civilization, which are in the thoughts of all of you, and to challenge engineering leadership in the solution of them.

An outstanding leader in engineering is now the leader of our nation, and we know that he is thinking of all these things and seeking right solutions. For he has said, "The outstanding problem and the ideal of our economic system is to secure freedom of initiative and to preserve stability in the economic structure in order that the door of opportunity be open to all citizens; that every business man shall go about his affairs with confidence in the future; that it shall give assurance to our people of a job for everyone who wishes to work; that it shall, by steady improvement through research and invention, advance standards of living to the whole of our people."

Of course, in all this discussion of coördination it is understood that industrial statesmanship must accept with whole heart and all sincerity the new objective of industry—not profit, but service—a service which means determining the needs of man and providing them in the highest quality at the lowest possible cost.

Throughout this meeting we shall be considering the subject of the teacher and his work. Engineering leadership is born in engineering education. A great responsibility rests to-day upon you as teachers of engineering. You are the real leaders in engineering, for you will equip the young engineer with the elements of knowledge which will best enable him to take up his life's work and carry it forward with the confidence you have given him in his own intellectual development. Industry has come to value in the graduate more than all else, a firm background of fundamental science and engineering principles, realizing that it is the responsibility of industry itself to train the young men in its own specializations. One demonstration, of course, of engineering leadership in education, is the wisdom shown in the structure of the curriculum. The evidence which Dr. Bishop will present shortly, confirms your wisdom in this field.

Speaking for the moment from the viewpoint of industry, we who make a conscious effort to employ the engineering graduate, secure him, we hope, for future leadership. We are not employing him for the small job that is available to-day. We want him when coming to us, to attack each problem in a thoughtful way, to relate the small job first assigned to him, to those of his associates and of his superiors, so that he will grow in ever broadening comprehen-

sion. Then, when he comes to that period ten or fifteen years hence, when he has passed through the lower supervisory levels in staff or operations, and emerged into an executive position, he will know how to respond to the demands imposed on him and be able to solve the serious problems which confront him. With your help and his subsequent experience, he will then have prepared himself for the higher realms of engineering leadership, yes, of industrial statesmanship.

While you are responsible for his earlier development, you will help him to develop character; you will give him fundamental knowledge; you will teach him how to get along with his fellows, and give him a realization that the greatest problem which he will face in his life's work is that of human relationships; if he has a bent for scientific research, you will encourage it, guide him and direct him in graduate work. From you he will get the realization of the value of truth and apply those values in engineering method of thought. Through you he can face the world with trained intelligence. Finally, with your constantly improving standards of teaching, you are developing within the student, a true culture. Those present who heard the inspiring talk of Dean Anthony before the Summer School in Drawing last Friday, know what I mean. He denied that culture comes from the subject, but asserted that it develops out of the manner of teaching any subject. More and more has science become the basis of intellectual advancement, and culture may come out of the proper teaching of drawing, descriptive geometry, mechanics, and thermodynamics, and in fact all subjects in the engineering curriculum. We will all agree, I am sure, that this type of curriculum in higher education can inspire in the student a higher and broader vision of the realities of life.

Therefore, as developers of the world's future leaders, you take your place in engineering leadership, and in fundamental work in research you fortify that position. There can be no nobler profession than that of teacher—developer of men. There is a constant, enduring, and ever present inspiration for the teacher in his work.

DISCUSSION:

A. A. Potter: We are very greatly indebted to the President of our Society, Dr. Rees, for a very clear conception of our responsibilities and opportunities as teachers of engineering, to train leaders who will be able to direct wisely the great developments in science and in engineering, engineers who, as Dr. Rees stated, will insure a steady march of progress toward civilization.

As for our engineering curricula, from the standpoint of the industries, it is most encouraging for us teachers to learn from

General Rees that he considers them well suited to develop in students a broad vision of the realities of life; also, that he feels that engineering leadership is borne of engineering education. However, if our curricula are to train engineers who can improve our social order, it is our greatest responsibility as teachers to develop character, to train for clear thinking, and to inspire in our students an appreciation of the human relationships which must exist in all problems confronting the engineer.

R. L. Sackett: President Rees has spoken from the point of view of a leader in and of industry, and in doing so he has paid us a high compliment, and at the same time placed on us a responsibility so great that it is almost overwhelming. He has pointed out certain weaknesses of the industrial structure of which he is a part, and has called upon the engineer to participate in the correction and the prevention of some of the defects of our social organization, which is so closely related to our industrial setup.

He has, in reality, asked the engineer to become the practical economist of the future. He has asked the engineer to assume a certain type of social leadership which he formerly refused as a profession. He has pointed out to us that a certain new form of coöperation and coördination will be necessary in order to remove some of these stains from the body politic. By inference he means that with that coördination there must be further limitation of our liberties, because democracy itself means the restriction of the liberty of the individual to do as he pleases, and if society is finally to see clearly these facts, it is, I believe, going to be through the position which the engineer takes as he faces these problems, stripping them of their non-essentials, of their local political appeal, as President Hoover has attempted to do in the presentation of the problems which he has placed before the American public. Certainly the engineering professions ought to support the President of the United States in that attitude toward these great political problems.

If the engineering teacher is to be a force in this future evolution of society, he then must accept a very great responsibility. And, if he is to become to the student of the future that more nearly perfect guide and philosopher and friend, he will be something more than a teacher of technique. He will be a man who contributes out of his innermost self to the development of the cultural side, to the development of that interest in these larger problems which the engineer must begin to think about if he is to assume these larger responsibilities.

F. E. Turneaure: I have been very much impressed by the expressions of our hosts and our President, regarding the great re-

sponsibility of the engineering teacher. I have also thought back over past history, as a man of my age is apt to do, and remarked the great contrast between the number in this audience and the character of our address, coming from a man in industry, with the meetings and programs of twenty or twenty-five years ago, when I think our work was not so greatly valued by industry as it is now. Nor were our responsibilities so highly rated as they are at the present time.

Our addresses from our hosts and our President, show pretty clearly that we have got to do our best along educational lines, not alone in applied science, but in human relations, and should lay more emphasis upon the latter than we have done in the past. An engineer needs to be more than a man who figures out things; he must also be articulate, and must understand human relations. Perhaps we forget the very small proportion of our voting population that thinks scientifically and rationally. Our big problems are not often solved; our political problems are very rarely along strictly rational lines, and I believe if our engineering graduates would appreciate that fact more thoroughly and take into account the element of human relations, they would have more influence in getting those problems solved in a rational manner.

I cannot help but think, particularly by reason of the fact that one of our hosts is L'Ecole Polytechnique, of the great influence of French engineers in public life in France, much greater, apparently than has been the case in this country, but I anticipate a gradual change in this respect in the future. Our present President of the United States is an example which I hope will be repeated, but I think we all realize that some of his difficulties that he is encountering are due to the fact that many of our problems are not solved rationally.

President Frank, of the University of Wisconsin, is prone to express his belief in the great need of getting more science, more of the engineering method, more rationality into the solution of our economic and social problems.

So I think we can return from this meeting with a more thorough realization of our responsibility, and also with a considerable amount of encouragement in our big job of education. We have a great deal to thank our President for in focusing our attention on this particular phase of our job.

ADDRESSES OF WELCOME

By AURELIEN BOYER

Principal and President of the Governing Board of L'Ecole Polytechnique

You have taken as watchword for this meeting "The Teacher and His Work." Will you allow me to tell you in a few words of a simple lesson I received some thirty years ago, and of the teacher who was a very humble man who probably does not know to this day what influence this lesson has had on my whole career.

In 1899 the Canadian Government, at the request of authorities of the Yukon Territory, and later to accommodate the military authorities of Alaska, had undertaken the construction of a telegraph line from Dawson City and beyond to the boundary of Alaska at Fort Egberton and South to Quesnel in the old Caribou District of British Columbia, a distance of over 1700 miles. My mission was to find a route through the wilderness by valleys and passes through the mountains for this telegraph line. My only companion in preliminary explorations was an Algonquin Indian from the Province of Quebec who came to me recommended by the Hudson Bay Company. He had a long name, so we called him Pete, for short. This Indian was so at home in this strange and new land, that I had come to look upon him more as a host and a friend rather than a servant. One day in the summer of 1900, we were sitting alone together on the edge of a basaltic plateau, South of the Stikine River, at an altitude of about 4000 ft. just above the timber line. We had followed around the base of this plateau for several days and had just climbed to this spot. While resting I had plotted in my note book the route we had come over, and had made a sketch of the country around us. I can remember to-day, as if I was there yet, the beautiful panaroma that stretched before us: To the West and South in the distance, nothing but lofty snow capped peaks, and I remember wondering how we could ever get through, below us the depth of a valley where I could see a stream, white and rich with the grists of the glaciers, winding its way through the dark green of the balsams of the forest. Immediately below us and nearer, immense hexagonal crystals of basalt breaking through the drift and forming gigantic steps or palisades, and to the northeast for a long distance, the flat table top of the plateau, the feeding ground of caribou herds. I had laid my prismatic compass on the moss, beside me, pointing towards the camp we had left

several days ago, and where we had decided to return by taking a short cut across the table land. I asked my Indian companion what direction we should follow to go back, and he pointed within a few degrees of the bearing which my compass indicated. There was a question I had often wanted to ask him, but every time I had hesitated, as it seemed to me each time a silly question to ask. On this occasion I was so amazed at the accuracy of his judgment, that I asked him: How do you do it Pete, have you got a sixth sense for direction? He paused for a moment, and I could see lines of pity and irony around his mouth. He answered, "No, we, Indians, have not got a sixth sense, *we look where we go.*" Then he told me how, he did not observe the landscape in front of him only, but to the right and to the left, that he often stopped and looked back, so as to absorb the lay of the land from every possible angle. He added, the white man he goes where he looks, swayed to one side or the other by the beautiful colors of butterflies, or the antics of small animals that cross his path; when he turns to go back, he is surprised to find the scenery before him entirely new, and he is lost, because he never looked back.

Gentlemen, when I observe this distinguished and numerous assembly, and when I think of the wealth of knowledge and the wealth of experience which all of you together have brought to this meeting, and when I take into consideration the extent of your program, I wonder if again the rôles have not been changed and if, instead of being the host that receives you, we are not the guest that will sit at your table.

Although inspired by the French schools of engineering, and dominated by our Latin mentality, we have nevertheless on several occasions let ourselves be guided by your advice, through your yearly proceedings and your Summer schools. And if I am allowed to carry the parallelism further, I cannot help but compare you to my old guide who on several occasions had pulled me out of difficulty, and whom I had come to love and respect as a true friend.

Is not the object of your society to "look where we go" and year after year have you not paused to look back? As I also look back, I hear the sounds of an echo, "Teach Fundamentals" repeated from year to year, which has been a great comfort, a great encouragement to us. To-day and the next two days we will be sitting together on the high plateau to which you have raised yourselves through your efforts, looking to the right, looking to the left, looking forward and bending over the past; again we have set our compass by our side and we are waiting to see if your hand will point in the direction we have chosen, but whether it points to the right or to the left of our course, we will try to follow you to the extent of the means at our disposal and within the limits of our influence.

It is with this spirit, with these feelings that I have the pleasure, and I deem it a great honor, to extend to you on behalf of l'Ecole Polytechnique our heartiest welcome.

By SIR ARTHUR CURRIE

Vice Chancellor and Principal, McGill University

Let me at once express my deep sense of the honor that is mine in being privileged to address the members of the Society for the Promotion of Engineering Education. In the name of McGill University I bid you a most cordial welcome to Montreal and to this University. It is appropriate that I, as principal, should do so. Our engineering school is one of our best and most useful schools. Though we are proud of it, proud of its staff, proud of its graduates, gratified at the part they have played in the development of this country, in the contribution they have made to increase the measure of health and prosperity and the comforts of living enjoyed by our people, we are not unmindful of the fact that greater efficiency is the watchword, not only of the engineer but of the engineering school. If he who welcomes you should be an authority on engineering education, then I am badly chosen. But if he is one who appreciates the engineer for what he has done, can do, and will do, then I am satisfied to be chosen, for I yield to none in my admiration of him and in my sense, bordering on awe, even on veneration, of the magnitude of his achievements and the honored place he occupies, or should occupy, in our national life.

There is now a great bond between the university and the engineer. It was not always so. In fact, I do not think it is too much to say that engineering is a profession—a highly respectable and important profession—because the university made it so. On the other hand, it would not be unfair to say that from the time the universities undertook the training of engineers, they became vastly more useful institutions.

The term "Applied Science" tells the story. There was a time when men attended universities to fit themselves—if they regarded university training in any other light than as a decoration—to serve the state as teachers, as preachers, as lawyers, as civil servants, as parliamentarians, as writers. University education concerned itself with a study of languages and literature, of history, of mathematics, of philosophy—those subjects which we term The Humanities. But deeper study of the mysteries of the natural sciences, of physics, of chemistry, of astronomy, made man curious to find out and determine whether the forces of nature could be controlled and harnessed and made to serve him. Man has always been willing to struggle with nature, to master her secrets, to bend her to his will.

Nature has always been a challenge to man. She was shy, deep, mysterious, powerful and beautiful. She excited him, dared him, revealed her secrets grudgingly, taunted him, inspired him, rewarded him, but one cannot yet say that the union is perfect and complete, though, so far, it has been happy and interesting, highly productive of good things and promising many more.

No field of university endeavor has yielded results comparable to the knowledge acquired with regard to the constitution of matter and the forces working within nature. The greatest march forward across the fields of time has been made in the last one hundred years; in the last fifty it has been in quick time; in the last twenty we have taken it at the double. If we think of the application of natural forces, of what that has done for productive industry, for the transportation by land and water, when we consider the means we now possess for the transference of thought, irrespective of distance, and of the prodigious stimulus to population as well as wealth which the knowledge of these natural forces has produced, we shall think of the most extraordinary phenomena experienced in all the ages of human history. Yes, the great advance of knowledge in modern times has been in the domain of science. As Lord Bryce once said, "Look in all other fields, and you will find no field in which, during this century and a half back, so great a crop and precious a crop has been reaped as in the field of natural science." The engineer has helped to reap that crop.

I might take time here to dilate upon man's victories over natural forces, but, after all, rewards of these victories are apparent on every hand. People of all classes appreciate that our manner of living, our buildings, our modes of travel, our daily routine of life, have been completely altered, even in our own lifetime, and that in these tremendous developments engineers and engineering have played the greatest part. New means of communication, new sources of power, have helped to bring about an almost incalculable economic change. International politics have been revolutionized by the telegraph, the wireless, the aeroplane, and the end is not yet.

Obviously, with all these changes, education had to change, too, change in system, in outlook and in purpose, if it were to keep pace with the new environment. The deeper waters of ancient knowledge and experience flow on as before, but they have changed in color and content because to them have been added the streams of new knowledge and new learning which have changed the face of the world in which we live. Education, particularly higher education, once the privilege of the few, is now within the reach of all, while the field it covers has broadened considerably, even so much as to make some of us wonder if at times we see the trees only and do not observe the forest.

Let me make brief reference to engineering education. What has been the knowledge that has enabled the engineer to achieve so much? The answer is, a knowledge of forces of nature and the ability to see how this knowledge can be made to serve the problems of mankind in all their infinite variety. It follows, then, that in the education of an engineer provision must be made not only for the teaching of these sciences, but also of training men in the methods of scientific research, of interrogating nature, of adding new knowledge to our present store, thus broadening out the field for further advance into the unknown and looking to a more complete mastery of the forces of nature, to the end that we may achieve for mankind results that at present live only in the land of dreams. This field of research in pure science is apparently illimitable, and the unravelling of the secrets of the material universe in the faith and hope that we may finally reach a completed understanding of the intricate and wonderful pattern of the "living garment of deity" is beyond all doubt a task not only of entrancing interest, but one of highest and noblest aim that can engage the mind of man.

The first obligation of an institution for the training of engineers is to see to it that capable men and sufficient facilities are provided for giving them a knowledge of the natural sciences and to implant in their minds a desire to consider the way in which that knowledge can be applied to the improvement of man's estate.

An engineer is a professional man, conforming to those ethical standards which should characterize professional life. He is an educated man. At least, he must have a sound scientific training and above all he should have enthusiasm and imagination. He should be a creator. If he lacks the power of vision, if he cannot create, he becomes little more than a superintendent of works. It is hard to give men the power of vision, but at least I think you should be able to keep the deadwood out of your profession. "Imagination is the ruler of the human race," said Napoleon, and he conquered the hosts of his enemies. His deadliest opponent was a man who possessed the soul of a poet, though he thought in ships and guns. The secret of the "Nelson touch" was the vision which let Nelson presage the confusion his tactics would create in the opposing fleet, and enabled him to forsee a victory won as much by moral as by physical force. Imagination has had no less a share in the conquest of nature. Canada furnishes many examples. The story of the Intercolonial railway and the Canadian Pacific railway are dramatic chapters in our history. Such imagination is the real power which has brought your own profession to the place it occupies today on this continent. That imagination will enable you to do still greater service. The task of the engineer is far from being over. The world has many problems which we must look to

him to solve. Our cities have become hives of teeming millions. How are these crowds of human beings to be fed, clothed, and carried from place to place? How are they to be housed in healthy surroundings, furnished with heat, light and water? How can the life of the people be given all the ameliorations that science alone can give it? The problem of human relations is one of vital interest to the engineer, and to him we must look for help and guidance. In our social life, our industrial life, our business life, our economic life, the engineer has played, and still more in the future will play, a most important rôle. His accurate technical knowledge has made him a leader in business and manufacturing. He must work hand in hand with the economist. His counsel is sought by the banker and the statesman. How necessary is it, therefore, that his education and training should be the acme of excellence!

Gentlemen, you have come to consider a most important problem, one of those problems that concerns a much larger group than the members of your profession and the schools where those members are trained. Keep your standards high. Forget standardization and concentrate on standards. Insist that the courses leading up to the engineering degree are not too highly specialized or, rather, that while highly specialized knowledge is essential, it is not everything. There should be a broad general culture basis on which the superstructure of specialism is raised. I believe that in an engineering course, hand in hand and side by side with the technological instruction should go some history, some literature or literary studies, and much economics, especially with those branches of the subject which deal with the relations of labor and capital, with the all important question of bonds, stocks, debentures, balance sheets, and the financing of great industrial corporations.

Between us, we have a great responsibility for we must try to turn out men, of whom it may be said, as it was said of Alexander Holley, "He was great in his far-seeing apprehension of the utility of things."

REPORT OF INVESTIGATION OF ENGINEERING EDUCATION, 1923–1929, VOLUME I

The first volume of the final report of the investigation of engineering education was completed in the spring and was sent free to all members of the Society who had paid their dues. If you have paid your 1930–31 dues and have not received a copy of the report, please notify the secretary, F. L. Bishop, University of Pittsburgh, Pittsburgh, Pa., and a copy will be sent to you.

The findings and preliminary reports of the investigation which had been printed, from time to time, in THE JOURNAL OF ENGINEERING EDUCATION, were brought together, revised and supplemented in the present complete report.

Volume II will be published during the current year and will be sent free to all members whose dues are paid.

MINUTES OF THE REGULAR SESSIONS OF THE THIRTY-EIGHTH ANNUAL MEETING OF THE SOCIETY FOR THE PROMOTION OF ENGINEERING EDUCATION

The thirty-eighth annual meeting of the Society for the Promotion of Engineering Education was held at Ecole Polytechnique and McGill University, Montreal, Canada, Thursday, June 26, to Saturday, June 28, 1930. The keynote of the meeting was "The Graduate and His Work."

On Wednesday evening at dinner, there was a meeting of the Council at the Mount Royal Hotel, and another meeting at breakfast on Saturday.

Registration headquarters was in the Main Hall, Arts Building, McGill University. There were 485 members and guests registered.

On Thursday morning, June 26, nine conferences were held:

Coöperative Engineering Education: D. C. Jackson, Jr., Chairman.

Railroad Work for Coöperative Students. J. E. McDaniel, Georgia School of Technology.

Coöperative Work in Aeronautical Engineering. F. K. Teichmann, New York University.

Engineering Education in School of Business Courses. George Filipetti, Columbia University.

An Experiment in Industrial Education. G. B. Thomas, Bell Telephone Laboratories, Inc.

An Industrial Viewpoint of Coöperative Training. E. B. Roberts, Westinghouse Electric and Manufacturing Company.

Drawing: Thos. E. French, Chairman.

Echoes from the Pittsburgh School.

Electrical Engineering: Paul Cloke, Chairman.

The Correlation of Electrical Engineering Education with Electrical Industry. Fred H. Pumphrey, Rutgers University.

English: Sada A. Harbarger, Chairman.

Some Developments on the Teaching of English in the Technical Schools of the United States. J. Raleigh Nelson, University of Michigan.

Experimenting in English with Engineering Students. R. del French, McGill University.

General Discussion: Comparison of Objectives and Methods in the Teaching of English to Technical Students in the United States and Canada.

Industrial Engineering, E. B. Norris, Chairman.

Can Industrial Engineering Be Taught? John M. Carmody, President, Society of Industrial Engineers, Editor, Factory and Industrial Management; and Allan H. Mogensen, Assistant Editor, Factory and Industrial Management.

A Study of Some Phases of Shopwork in Engineering Curricula. R. L. Sweigert, Georgia School of Technology.

Machine Design: Frank L. Eidmann, Chairman.

Theoretical Considerations in the Design of Gear Teeth. F. A. Mickle, University of Michigan.

To What Extent Should Problems Involving Vibrations, Critical Speeds and Stress Analysis of Advanced Type Be Considered in Undergraduate Courses?

Discussion led by R. C. H. Heck, Rutgers University.

The Relative Value of the Teaching of Machine Design with and without the Making of Drawings.

Discussion led by W. V. Dunkin, Georgia School of Technology.

Mathematics: William J. Berry, Chairman.

Geometry, Its Place in the Curriculum and Methods of Presentation. Louis O'Shaughnessy, Virginia Polytechnic Institute.

The Teaching of Calculus. Egbert J. Miles, Yale University.

The Application of Mathematics to the Problems of Engineering. Thornton C. Fry, Bell Telephone Laboratories, Inc.

Tentative Plans for the Proposed Summer School for Mathematics to be held by the S. P. E. E. in 1931. H. P. Hammond, Director of S. P. E. E. Summer Schools for Engineering Teachers.

Mechanics: A. P. Poorman, Chairman.

A Study of the Correlation of the Student Grades in Mechanics with his Grades in the Prerequisite Subjects.

Percentage of Failing Grades in Mechanics.

Mining and Metallurgy: W. O. Hotchkiss, Chairman.

Mining and Metallurgy Curricula.

Reports of these conferences will be published later in the JOURNAL OF ENGINEERING EDUCATION.

THURSDAY, JUNE 26, 1930

The opening session of the thirty-eighth meeting was held in Moyse Hall, Arts Building, McGill University. The meeting was called to order by the President of the Society, R. I. Rees, Assistant

Vice President, American Telephone and Telegraph Company, New York City. Our hosts, Ecole Polytechnique and McGill University, were represented by Aurelien Boyer, Principal and Member of the Governing Board, and Sir Arthur Currie, Vice Chancellor and Principal, respectively, who welcomed us to these institutions and to Montreal. President Rees responded for the Society.

Vice President Hitchcock took the chair and President Rees delivered his Presidential Address, "Engineering Leadership." In this address he "made a forceful plea for engineering leadership, and did not hesitate to call attention to certain fields in which the engineer had, as yet, made little progress, but where his services were grievously needed. In particular he spoke of the need for giving the same attention to the problem of distribution that the engineer had given so successfully to production. In referring to the problem of unemployment he called for an earnest consideration of it by engineers and asked, "Will the time ever come when no workers will have to seek for a job, but simply ask where it is?" In dealing with these subjects, President Rees emphasized the peculiar fitness of the engineer to deal with them, and also his responsibility to society to offer solutions. Specifically he reminded his audience that as developers of the world's future leaders they had an important rôle in engineering leadership which they could fortify through fundamental research, and closed by stating that the constant, enduring, and ever-present inspiration for the teacher lay in his work."

This address was discussed by A. A. Potter, Purdue University, R. L. Sackett, Pennsylvania State College, F. E. Turneaure, University of Wisconsin, and E. A. Hitchcock, Ohio State University.

President Rees resumed the chair and Secretary F. L. Bishop presented the results of the investigation of engineering education which gave us an opportunity to compare our progress to-day from the point where we were five years ago. The data were collected from questionnaires which had been sent out by the Office of Education, Department of the Interior.

At four o'clock, McGill University entertained the Society at a garden party held on the campus.

In the evening, the report of the Committee on Industrial Relations of the Institutional Division was presented at a meeting at which the chairman of the Committee, R. L. Sackett, presided. This report was entitled "Can the Engineering Student Be Taught to Manage Men?", and was presented by Elliott Dunlap Smith of Yale University. The report was discussed by Sam A. Lewisohn, New York City, Jos. W. Roe, New York University, J. A. Randall, Rochester Mechanics Institute, A. L. Williston, Dedham, Mass., and President R. I. Rees.

FRIDAY, JUNE 27, 1930

The second session was held at 9:30 A.M., in Moyse Hall, Arts Building, McGill University, with President Rees in the chair. This session was devoted to "Personal Relations of Teachers." The subject was divided into five groups with the following speakers: "With Fellow Members of the Faculty," J. W. Barker, Lehigh University; "With Students," C. L. Kinsloe, Pennsylvania State College; "With the Community," Gen. C. H. Mitchell, University of Toronto; "With Industry," R. E. Doherty, General Electric Company, (paper read by E. E. Johnson in the absence of Mr. Doherty); "With National Engineering Societies," by Calvin W. Rice, Secretary, American Society of Mechanical Engineers.

The Nominating Committee, composed of past presidents and the elective members of the Council whose terms expire next year, presented the following report:

For President: H. S. Boardman, President, University of Maine.
For Vice Presidents: C. F. Harding, Purdue University, R. A. Seaton, Kansas State Agricultural College.
For Treasurer, W. O. Wiley, John Wiley & Sons, Inc.
For Secretary, F. L. Bishop, University of Pittsburgh.
For Members of the Council to Serve Three Years:
L. E. Akeley, University of South Dakota, Vermillion, S. D.
R. E. Doherty, General Electric Company, Schenectady, N. Y.
W. E. Farnham, Tufts College, Tufts College, Mass.
Augustin Frigon, Ecole Polytechnique, Montreal, Canada.
T. J. Hoover, Stanford University, Stanford University, Calif.
F. V. Larkin, Lehigh University, Bethlehem, Pa.
J. E. McDaniel, Georgia School of Technology, Atlanta, Ga.

Upon motion the nominations were closed and the Secretary cast the unanimous ballot of the Society for the nominees.

Past Presidents Turneaure and Potter escorted President-Elect Boardman to the platform. Mr. Boardman said: "I have been connected with this Society for twenty-seven years. I have always taken a very great interest in it and I count it an honor, a very distinct honor, to become its president. I stand before you with humility and the great desire to do my best during the coming year for the interests of the Society."

L'Ecole Polytechnique entertained the Council and invited guests at a luncheon at the Cercle Universitaire.

The third session was held at the Sulpician Library, L'Ecole Polytechnique, with Vice President Bennett in the chair. This session was devoted exclusively to the address of Dr. Leo Pariseau on "The Contribution of the Electrical Engineer to Medical Science." This was illustrated.

The annual dinner was held at the Mount Royal Hotel with President Rees presiding. Mr. O. W. Eshbach presented the report of the Committee on Lamme Award concluding his report with the remark that "In recommending this recipient we not only honor him but we honor ourselves for none of the 7,000 eligible candidates has contributed more to the advancement of engineering education than has Charles Felton Scott, Professor of Electrical Engineering, Yale University."

Deans Sackett and Leland escorted the recipient to the chair where President Rees presented the third Lamme gold medal to Dr. Scott, saying, "Dr. Scott, your ability, capacity, and constructive imagination have contributed greatly in many fields of human endeavor, but out of our hearts we consider you greatest in the contributions which you have made for the promotion of engineering education. In the name of the Society and of each of the more than 2,000 members, and by the authority vested in me as President, it is a privilege and a high honor to present to you the Lamme medal."

Professor Scott accepted the medal with a few well-chosen words.

Edward R. Weidlein, Director of the Mellon Institute of Industrial Research, University of Pittsburgh, spoke on "Industrial Research Methods and Workers," and Walter W. Colpitts, Consulting Engineer and graduate of McGill University, spoke on "The Engineer and Finance."

Saturday, June 28, 1930

The fourth session was held at Moyse Hall, Arts Building, McGill University, and President Rees called the meeting to order at ten o'clock.

The report of the Treasurer, which had been audited, was read by the Secretary in Mr. Wiley's absence from the country. The report was accepted and ordered printed in the JOURNAL.

The report of the Secretary was read and ordered printed in the JOURNAL.

H. P. Hammond, Director of Summer Schools for Engineering Teachers, reported on the Drawing Session which had just been concluded at Carnegie Institute of Technology and on the Civil Engineering Session which was to be held at Yale University beginning the next week. He also presented tentative plans for schools for 1931.

Charles F. Scott, Chairman, reported for the Board of Investigation and Coördination, stating that the first volume of the final report was now in the hands of the members and that the second volume would be forthcoming shortly.

D. B. Prentice, Lafayette College, read his paper "Measuring

the Product of Engineering Schools," and S. D. Sarason, Syracuse University, presented his paper, "Aerial Photo Surveying and Mapping." Both papers were accompanied by lantern slides.

Augustin Frigon, Director-General of Technical Education for the Province of Quebec, and Robert H. Spahr, General Motors Institute of Technology, discussed technical institute education in Canada and in the United States.

The Committee on Resolutions presented the following report:

"As the thirty-eighth annual meeting of the Society for the Promotion of Engineering Education approaches its closing session in Montreal, the members in attendance recognize anew the important part which these regular gatherings play in fostering the ideals and in advancing the purposes of the Society.

"Mindful of the values received and of the inspiration to further endeavor accorded by these conferences, and keenly cognizant of the preeminent contributions of the host institutions which have made this meeting so enjoyable and so successful, the Society hereby records in all too inadequate words its sincere thanks and appreciation to all who have so cordially and untiringly contributed to the comfort and entertainment of the members and their families.

"To the Chancellor, Vice-Chancellor, and Governors of McGill University, for their generous placing of meeting facilities at the disposal of the Society; for the hospitable and inspiring welcome; and for the delightful entertainment afforded by the Garden Party; to the Principal and others of the Governing Board of L'Ecole Polytechnique, for the gracious tender of their halls; for the charming welcome; and for the bounteous luncheon to Council and guests; to the members of the several local committees, and especially to the Ladies' Entertainment Committee, for the excellently planned and carefully administered activities which so abundantly contributed to the comfort and pleasure of every member; to the guest speakers whose addresses furnished such a wealth of inspiration and encouragement; and to all those industrial firms which so kindly placed their plants at the disposal of members for inspection;

"The Society feels that this, its second meeting in Canada, has been one of its most successful and enjoyable, and looks forward with the happiest anticipations to some future return to enjoy again the many courtesies and bountiful hospitality of its Canadian friends."

The fifth session was held in Moyse Hall, Arts Building, McGill University. Vice President Hitchcock called the meeting to order at three o'clock. This meeting was devoted to the subject of "Research" with the following speakers: F. E. Lathe could not be present and was represented by Dr. Parkins who is in charge of Aeronautical Division of the National Research Council of Canada; R. A. Seaton, Kansas State Agricultural College; H. H. Higbie, University of Michigan; C. F. Harding, Purdue University; Thornton C. Fry read the paper of John Mills, Bell Telephone Laboratories, Inc., who was unable to be present.

T. M. Focke, Chairman, Committee on Coördination of Preparatory and Engineering Education, presented the report of that committee.

The Secretary presented the report of the Committee on Graduating Personnel.

The meeting adjourned at five o'clock to meet at Purdue University, Lafayette, Ind., in June, 1931.

MINUTES OF THE COUNCIL MEETINGS

The following are the minutes of the Council meetings held at Montreal, June 25–28, 1930.

Present: President R. I. Rees, Vice-Presidents, E. A. Hitchcock, Edward Bennett, Secretary F. L. Bishop, L. E. Akeley, H. S. Boardman, J. M. Bryant, Paul Cloke, C. S. Coler, I. C. Crawford, R. C. Disque, W. E. Farnham, T. M. Focke, R. C. H. Heck, H. H. Higbie, H. P. Hammond, C. F. Harding, W. C. Huntington, S. S. Edmands, D. C. Jackson, A. C. Lanier, O. M. Leland, J. E. McDaniel, C. M. McKergow, G. B. Pegram, A. A. Potter, D. B. Prentice, H. S. Rogers, N. C. Riggs, R. L. Sackett, C. F. Scott, R. A. Seaton, A. N. Talbot, W. H. Timbie, F. E. Turneaure (35).

The report of the Secretary was read and ordered printed in the JOURNAL OF ENGINEERING EDUCATION.

The request of Lehigh University that this Society send them a list of representatives to whom invitations to the dedication of the James Ward Packard Laboratory of Mechanical and Electrical Engineering next October, may be sent—the Secretary instructed to send them the names of the past officers and members of committees.

Invitations for the 1931 meeting were received from Purdue University and Stanford University. Lafayette College extended an invitation for 1932 which is their centennial year. The invitation of Purdue University was accepted for the 1931 meeting of the Society.

The Council voted that a committee be appointed to consider the advisability and the practicability of classifying engineering colleges and that this committee report to the Council in 1931.

The Director of the Summer School for Engineering Teachers, H. P. Hammond, reported on the School on mechanical engineering at Purdue in 1929, the Drawing session at the Carnegie Institute of Technology and the Civil Engineering session at Yale University in 1930. For 1931 we have an invitation from the American Institute of Chemical Engineering, also from the University of Michigan, to hold a session on chemical engineering. The Council approved the holding of the 1931 school on chemical engineering at the University of Michigan contingent on securing the necessary funds.

The Mathematical Association of America and the American Mathematical Society approve the holding of a session of teachers of mathematics to engineering students if held at the time and place

of the meeting of the two societies in the late summer of 1931 at Minneapolis. The Council approved the holding of this session at the discretion of the Board of Investigation and Coördination and contingent upon securing the necessary funds.

Director Hammond also reported that the number of colleges, which send representatives at the expense of the institution, are increasing.

Council expressed its appreciation of Director Hammond's splendid manner in conducting and organizing summer schools.

C. S. Coler, Chairman of the Committee on the Lamme Award, made a motion, which was seconded and carried, that the Committee one year from now make a definite recommendation concerning the publication of a booklet containing pictures together with brief descriptions of achievements of recipients of the award.

With regard to the suggestion that "members having performed a signal service to the Society should be designated Fellows, and others members" the Council felt that the Society has, from the beginning, been democratic and that no distinction should be made among the members.

The Council instructed the Secretary to correspond with the secretary of the Association of Junior Colleges suggesting closer coöperation and ascertain if a committee of each might consider some of the common problems of the junior and of the engineering colleges. Motion that a committee on junior colleges be appointed to consider the relation of junior colleges in engineering and engineering schools and report to the Council in 1931.

Council authorized the appointment of a committee of personnel directors and college professors to consider existing practices and to determine whether they best serve the three interests concerned and possibly some other plan of recruiting, and to report at the 1931 meeting.

Council appointed A. N. Talbot, D. B. Prentice and Edward Bennett as a committee to study the question of this Society making nominations for the Popular Science Monthly $10,000 annual award for 1930. At a later meeting, the Committee reported that it was their feeling that if nominations were to be made from this Society that they should be made for work in education and it was not ready to propose any nomination at this time. For this reason, the Committee reported that no nomination should be made for 1930.

H. H. Higbie, University of Michigan, explained the purpose of the Stump Speaker's Society—membership open only to students in colleges of engineering and architecture and schools of technology.

An invitation was extended to the Society to participate in the International Road Congress to be held in the United States in October, 1930.

The President was authorized to appoint a committee to consider the communication from G. T. Seabury, concerning the Recommended Uniform Registration Law for Professional Engineers and Land Surveyors and to report back to the Council.

The report of the Treasurer was read and ordered printed in the JOURNAL OF ENGINEERING EDUCATION.

It is the sense of the Council that the Society for the Promotion of Engineering Education should be a member of the American Engineering Council but we are not yet confident of our financial ability to join.

Council voted that we recommend to the Society that the name of the Society for the Promotion of Engineering Education be changed to Engineering Education Society.

The Committee on Instruction in Industrial Relations was continued for another year.

Council authorized the appointment of a committee to consider engineering degrees as relating to the four founder engineering societies.

Motion that a survey of vocational guidance practices prior to enrollment and during the first year in engineering schools; study of personnel methods in use in engineering schools; and a survey of methods and procedures of administration for improving educational and instructional standards be referred to the existing committee with the urgent recommendation of the Council that they be studied intensively during the coming year and reports be presented at the next annual meeting.

The Executive Committee was instructed to coöperate with the Office of Education, Department of Interior, to obtain such information as we desire and to see that in the publications of that Department we are properly represented in number of pages and type of material.

The Secretary was instructed to express our appreciation to the Office of Education for the hearty coöperation we have been receiving.

The Chairman of the Board of Investigation and Coördination, C. F. Scott, reported that the first volume of the final report was now in the hands of every member who had paid his dues, and that the second volume would be issued shortly.

Council voted that this Society enter wholeheartedly into participation in the World's Fair in Chicago in 1933 and the Executive Committee is given power to formulate plans and to coöperate with other agencies. The retiring president, R. I. Rees, is to be a member of this Committee. The Executive Committee may add other members to the committee at its own discretion.

Council approved the following budget for 1930–31:

RECEIPTS

Individual Dues	$ 9,500.00
Institutional Dues	1,785.00
Back Dues	500.00
Advertising	2,000.00
Sale of Publications	350.00
Estimated Receipts	$14,135.00

DISBURSEMENTS

A.	1930 Meeting	$ 600.00	
B.	Journal, Proceedings, Year Book	7,500.00	
C.	Committee Expenses	150.00	
D.	Secretary's Honorarium	1,200.00	
E.	Clerical Assistance	3,300.00	
F.	Sundry Printing	300.00	
G.	Postage	300.00	
H.	Telephone and Telegraph	50.00	
I.	Supplies	200.00	
J.	Traveling Expenses	500.00	14,100.00
	Estimated Surplus		$ 35.00

Council approved the election of the following applicants:

Ananthanarayanan, Sivaramakrishna, Principal, School of Civil Engineering, 10, Pandadiaml, Andar Street, Teppakulam Post., Trichinopoly, India. F. L. Bishop, Nell McKenry.

Baldwin, Leo S., Assistant Professor of Drawing, University of Wisconsin, Madison, Wis. H. D. Orth, C. V. Mann.

Boyer, Aurelien, Principal, Ecole Polytechnique de Montreal, Montreal, Canada. A. Frigon, T. J. Lafreniere.

Bukovsky, Paul N., Assistant Professor of Mechanism and Engineering Drawing, University of Michigan, Ann Arbor, Mich. F. R. Finch, G. A. Morley.

Circe, Armand, Professor of Strength of Materials, Ecole Polytechnique de Montreal, Montreal, Canada. A. Frigon, O. Lefebvre.

Doty, L. Donald, Instructor in General Engineering Drawing, University of Illinois, Urbana, Ill. H. H. Jordan, G. J. Hood.

Dunham, Earl M., Instructor in Engineering Drawing and Descriptive Geometry, University of Maine, Orno, Me. F. G. Higbee, Alva Mitchell.

Frey, George J., Head, Department of Mechanical Engineering, Ohio Mechanics Institute, Cincinnati, Ohio. C. L. Svensen, T. E. French.

Huffmon, Raymond L., Instructor in Engineering, Loyola University, Glendale, Calif. D. M. Wilson, G. H. Dunstan.

Kennard, Harold J., Assistant Professor of Graphics, Lafayette College, Easton, Pa. H. P. Hammond, F. G. Higbee.

Kepner, Harold R., Assistant Professor of Civil Engineering, Utah Agricultural College, Logan, Utah. H. M. McCully, T. E. French.

Landreau, Georges L., Professor of Engineering Drawing, Ecole Polytechnique de Montreal, Montreal, Canada. A. Frigon, O. Lefebvre.

Leet, Horace W., Professor of Machine Design and Mechanical Drawing, University of Rochester, Rochester, N. Y. H. M. McCully, T. E. French.

Lichty, Lester C., Associate Professor of Mechanical Engineering, Yale University, New Haven, Conn. S. W. Dudley, W. J. Wohlenberg.

Miller, John B., Instructor in Electrical Engineering, Bucknell University, Lewisburg, Pa. F. E. Burpee, F. L. Bishop.

Nettleton, Ernest M., Assistant Professor of Drawing and Descriptive Geometry, Carnegie Institute of Technology, Pittsburgh, Pa. H. M. McCully, W. E. Mott.

Payrow, Harry G., Assistant Professor of Civil Engineering, Lehigh University, Bethlehem, Pa. J. C. Tracy, H. P. Hammond.

Shaw, Robert P., Secretary, National Research Council Advisory Committee, Chicago World's Fair, 40 West 40th Street, New York City. R. I. Rees, A. A. Potter.

Singer, Ferdinand L., Instructor in Engineering, New York University, New York City. H. C. Hesse, B. M. Green.

Slantz, Fred W., Professor of Graphics, Lafayette College, Easton, Pa. H. P. Hammond, F. G. Higbee.

Smith, G. Wallace, Associate Professor of Engineering, University of North Carolina, Chapel Hill, N. C. F. G. Higbee, W. G. Smith.

Townsend, Clarence E. Professor of Engineering Drawing and Descriptive Geometry, Cornell University, Ithaca, N. Y. Thos. E. French, H. P. Hammond.

Wendling, Andre V., Professor of Physics, Ecole Polytechnique de Montreal, Montreal, Canada. A. Frigon, O. Lefebvre.

Whenman, John H., Instructor in Mechanical Engineering, Worcester Polytechnic Institute, Worcester, Mass. F. G. Higbee, W. G. Smith.

Wilson, Earl R., Instructor in Engineering Drawing, University of Akron, Akron, Ohio. F. G. Higbee, Fred S. Griffin.

Respectfully submitted,

F. L. Bishop,
Secretary.

REPORT OF SECRETARY, F. L. BISHOP, 1929–30

Membership

No membership committee was appointed during the current year. The campaign for members was conducted in the Secretary's office, very largely by the assistant secretary. We have added 218 new members to the rolls since our last meeting, 3 by reinstatement, 203 by election and 12 applications pending. We have lost 13 members by death (list attached) and 92 have resigned or have been dropped for non-payment of dues. We have, therefore, an increase in membership of 114 over June 1929. We now have 2211 individual and 119 institutional members, or a total of 2330. However, there are 81 who will have to be dropped at the close of this convention for non-payment of dues, so that the actual membership will be 2249.

It is interesting to note in this connection that there are 22 charter members (list attached) still on the rolls of the Society, seven of whom are past presidents. We have 20 members (list attached) who are designated as Life Members.

Dues

The dues for all members are payable in advance at the time of the annual convention. This past year, your Secretary sent out two bills for dues. A third notice sent out was a red card which read "I don't like to send out bills any better than you like to receive them, but the duties of my office require that I send them out until you pay. . . ." Some of the comments on this notice are "Such a notice is a disgrace to the Society and does more harm than good." "My humblest apologies." A fourth notice was sent out of May 13 advising those who had not paid that they would not receive a copy of the final report of the investigation. As a result of these four notices, $10,579.00 was collected in current dues and $1,287.14 in back dues. At this writing, June 18, 1930, there are 129 members who owe 1929–30 dues, and 60 who owe 1928–29 and 1929–30 dues. In addition to these there are 81 members who owe more than $10 and these will be dropped for non-payment of dues at the close of this meeting. (List of delinquents attached to this report.)

Finances

The report of the Treasurer will show that the finances of the Society are in a satisfactory condition. (Auditor's report attached.)

Investigation of Engineering Education

Results: It was felt by many that it was very important to determine to what extent the results of the investigation which has been carried on by this Society had been effective in making changes in curricula, etc., of our engineering colleges. The President of the Society secured the coöperation of the Office of Education and questionnaires were sent out to all the engineering colleges. Replies have been received from 119. These results have been tabulated and will be presented at the first session of this convention.

Final Report: The first volume of the final report of the Board of Investigation and Coördination was completed in the office of the Secretary during the current year and is now in the hands of all members who have paid their dues. The editorial work connected with this added very materially to the burdens of the Secretary's office during the year.

Comparison of investigation of engineering education and of medicine:

The two professions, Engineering and Medicine, are more closely connected with the progress of the world than any other two professions—the first in employing the materials and forces of nature, and the latter in keeping men fit to work with these materials and forces.

What should be more fitting than, almost simultaneously, committees should be formed "to carry on a five-year investigation of medical education" and of "engineering education." In 1923, this Society appointed a committee and funds were secured to carry on such an investigation, and in 1925, a commission was appointed under the auspices of the Association of American Medical Colleges, "with funds donated from several agencies interested in the subject." The Society has issued sixteen pamphlets covering the results of the investigation of engineering education, and the Commission has issued three annual reports on medical education. Dr. N. P. Colwell, Secretary of the Council on Medical Education and Hospitals of the American Medical Association, quotes the third report in his article, "Medical Education, 1926–1928," which appears in Bulletin, 1929, No. 10, Department of the Interior, Bureau of Education.

A comparison of the report on medical education with those on engineering education shows many things in common:

1. (Medical) "The first duty of a medical School is to provide its students with a thorough grounding essential for every practitioner of the healing art."

"Engineering curricula aim to provide a thorough grounding in the principles of science and the methods of engineering, together

with elements of liberal culture intended to enrich the personal life of the student and fit him for a worthy place in human society."

2. (Medical) "Experts in graduate medical education now agree that an interneship to round out the student's undergraduate medical education, should be completed before the young graduate enters on his preparation for any specialty."

"The undue emphasis in medical teaching which is laid on the separate organs and systems which make up the human body rather than considering man as a complete living human being. This is resulting in a marked and dangerous trend toward specialization."

(Engineering) We believe the proper time for specialization is after the undergraduate course, and that in a majority of cases specialization must accompany active experience rather than take the form of a further discipline in college."

3. (Medical) The commission calls particular attention to the advisability of more electives in the curriculum.

(Engineering) General indications point to increasing latitude of election in recent years, although engineering curricula in general remain largely on a prescribed basis."

4. (Medical) The urgent problem is to ascertain how the benefits of modern medical care can be brought within the reach, both physically and financially, of the greatest possible proportion of the people."

(Engineering) The next phase of the effort of the Society should be to awaken the public to the importance of engineering education and research as factors in individual and social well-being."

The Commission calls attention to "The tendency to prolong unnecessarily the student's period of preliminary and professional education." Eight medical schools, out of the seventy-four recognized by the American Medical Association, have either adopted, or will adopt in 1930, the quarter system. Under the so-called quarter system a student can complete the four required college years of medical education of eight or nine months in three calendar years. Any three consecutive quarters of completed work would count as a "college year." The avowed adoption of this plan by the new school of medicine at Duke University has given fresh impetus to the movement and shows that the plan is feasible, even in the warmer climate of the Southern States. The Commission calls particular attention to "such shortening of existing courses as may be possible and the saving of time by the use of over-long summer vacations is strongly urged."

American Engineering Council

Negotiations have been carried on by your Executive Committee with the American Engineering Council looking to the affiliation

of this Society with that organization. A definite proposition will be presented to you at this meeting for action. The Secretary is of the opinion that the Society can be of distinct service to that organization and at the same time secure benefits for all engineering education.

The question of affiliation with the American Engineering Council is largely one of finances. It should receive careful consideration of the Council at this time.

Employment Service

The employment service which the Secretary's office has always carried on has been placed on a more formal basis. Circular letters were sent to all deans asking for information concerning vacancies and a statement was published in the Journal of Engineering Education stating that such service was available to all members. The Secretary's office in this way secured information of over thirty vacancies and received applications for positions from about twice that number.

Who's Who in the S. P. E. E.

At the last convention the Council authorized the preparation of a card index of Who's Who in the Society for the Promotion of Engineering Education. This has been prepared through the sending out of cards to all members. 955, or 43¼ per cent, returned these cards to this office. Of course, during the coming year we shall endeavor to make this complete.

Summer School for Teachers of Engineering

The establishment by this Society of summer schools for teachers of engineering has proved to be one of the most successful educational experiments of the present generation. Last year a session on mechanical engineering was held at Purdue. This year a session has already been held in drawing with an attendance of 100 at the Carnegie Institute of Technology in Pittsburgh, and a second one in civil engineering will start immediately after this convention at Yale. The Director of the Summer School, Professor H. P. Hammond, will report to you more in detail concerning these. An interesting feature of this work has been the alumni meetings of these schools which are held at the time of the annual convention.

Work of Committees

The work of your committees during the past year has been carried on in an energetic manner. It is, of course, not feasible to have all committees of the Society which are studying educational

problems report each year. However, this year some notable reports will be made—such as the Committee on Industrial Relations, R. L. Sackett, Chairman.

Conferences

A feature of the annual conventions which is becoming more important each year is that of the conferences held preceding the first session. This year you will note on the program nine conferences each of which has provided an interesting program for those who are especially interested in a particular feature of engineering education.

Year Book

The year book was published as early as possible. We attempted to have it issued in November but it was January before it was mailed to members. Early publication of the year book depends upon the effectiveness of the membership in returning their information cards.

Journal of Engineering Education

When the Bulletin of the Society now the Journal of Engineering Education was established in 1910, the Treasurer had the following remarks to make concerning it:

"The Bulletin publication involves an expenditure of considerably over $150 per month, but with the coöperation of advertisers and members we shall be able to carry this if dues are paid promptly."

The Journal of Engineering Education now costs us an average of $800 per issue of which the advertisers pay $225. The statement of the treasurer in 1910 still holds good. We can pay our bills if the dues are paid promptly.

Beginning with the September Journal we are to make the margins on the pages of the Journal less, consequently, include more words to the page and thus reduce somewhat the cost of printing. During the past year we have secured estimates on the cost of publishing the Journal from a number of other concerns. No one has been able to quote us a price as low as the Lancaster Press, Inc.

In order that the work of the Society may make distinct progress during the coming year, certain definite actions are necessary for the Council. I recommend that the information which has been secured during the present year through the United States Office of Education be continued and the Society formally thank them for their coöperation, and further that a committee be appointed with General R. I. Rees as chairman to continue this work.

You will note invitations from two institutions for the 1931 meeting. I think these invitations should receive this year especially careful consideration and that perhaps we should fix the convention not only for 1931 but for 1932. It is certainly desirable that we should have, in the very near future, a convention on the Pacific Coast in order that we may create more interest in the work of the Society among engineering teachers and others in that section of the country. The Society has never held a convention farther west than Boulder, Colo. We know that if we accept the invitation to meet at Purdue we shall have one of the most successful and largest conventions in the history of the Society. Its central location and the number of large engineering schools within a relatively short distance lead us to consider this matter very seriously.

In this same connection there will be presented to you a report of the special committee appointed by President Rees to consider what this Society should do to celebrate its fortieth anniversary at the Worlds Fair in Chicago in 1933. You are all familiar with the fact that the Society started as Section E at the Worlds Fair in Chicago in 1893.

Your Secretary recommends that each member invite personally at least two of his colleagues who are eligible to join the Society. If each member did this the scope of the Society would be broadened and we would not need a membership committee for 1930–31.

REPORT OF THE TREASURER, W. O. WILEY *

SOCIETY FOR THE PROMOTION OF ENGINEERING EDUCATION

STATEMENT OF CASH ACCOUNT

June 17, 1930

BALANCE ON HAND—JUNE 15, 1929		$ 6,689.80
RECEIPTS:		
Current Dues	$10,579.00	
Back Dues	1,282.14	
Dues in Advance	132.00	
Sales of Publications	2,281.38	
Advertising	2,286.72	
Interest on Daily Bank Balances	136.56	16,697.80
Total		$23,387.60
DISBURSEMENTS:		
Cost of Publications	$10,313.48	
Cost of Proceedings	456.90	
Honorarium for Secretary	1,000.00	
Clerical Assistance—Secretary's Office	3,000.00	
Traveling Expenses—Secretary's Office	446.01	
Printing, Postage and Office Supplies	996.06	
Committee Expenses	56.16	
Expenses—Columbus, Ohio Meeting—1929	572.48	
Expenses—Montreal, Canada Meeting—1930	377.87	
Dues—American Council on Education	100.00	
For Institutional Division, Personnel Problems	77.04	
Lamme Medal Fund Expenses (To be repaid)	210.35	17,606.35
BALANCE ON HAND—JUNE 17, 1930		$ 5,781.25

SOCIETY FOR THE PROMOTION OF ENGINEERING EDUCATION

INCOME AND EXPENSE ACCOUNT

At June 17, 1930, for the Year Ending June 30, 1930

EXPENSE

Cost of Bulletins	$ 8,737.17
Cost of Proceedings	456.90
Expenses—Columbus, Ohio Meeting	636.17
Honorarium for Secretary	1,000.00
Clerical Assistance—Secretary's Office	3,000.00
Printing, Postage and Office Supplies	996.06
Traveling Expenses—Secretary's Office	446.01
Committee Expenses	56.16
Dues—American Council on Education	100.00
	$15,428.47
Surplus for the year	999.73
	$16,428.20

* The accounts of the Treasurer are audited and the report of the Auditor is presented as the report of the Treasurer.

INCOME

Current Dues	$11,204.00
Back Dues	782.14
Sales of Publications	2,281.38
Advertising	2,024.12
Interest on Daily Bank Balances	136.56
	$16,428.20

SOCIETY FOR THE PROMOTION OF ENGINEERING EDUCATION

BALANCE SHEET

June 30, 1930

ASSETS

Cash:		
Current Fund	$5,781.25	
Petty Cash Fund	300.00	
Life Membership Fund	617.40	
Benj. G. Lamme Fund	537.70	$ 7,236.35
Securities:		
Benj. G. Lamme Fund		5,000.00
Prepaid Expenses—Montreal Meeting 1930		377.87
Inventory		470.50
Accounts Receivable:		
Current Dues	$ 500.00	
Advertising	585.00	
Lamme Medal Fund	1,235.63	2,320.63
Furniture and Office Equipment		183.35
		$15,588.70

LIABILITIES

Life Membership Fund		$ 617.40
Benj. G. Lamme Fund		5,537.70
Institutional Division: Personnel Problems Fund		827.72
Prepaid Membership Dues		132.00
Accounts Payable (Estimated)		1,500.00
Surplus Account:		
Balance—July 1, 1929	$5,974.15	
Surplus for this year	999.73	6,973.88
		$15,588.70

REPORT OF S. P. E. E. SUMMER SCHOOL FOR TEACHERS OF ENGINEERING

By H. P. HAMMOND, *Director*

I shall make this report very brief. It is proper I think that there should be an accounting made each year to the general meeting of the Society concerning the Summer School.

With the inclusion of the coming session at Yale, there will now have been seven sessions of the summer school devoted to six divissions of the curriculum. We shall have had a total attendance at the end of this year of 459 regular members of the group and nearly 200 members of the staff—a total of 650 teachers who have been brought intimately into contact with the summer school work. This is a very fair fraction of all of the teachers of engineering in the country, roughly, 10 per cent, and aside from a few duplications of men who have attended more than a single session, I think it is an index of the fact that whatever value the summer school may have is being felt in the institutions throughout the country.

The attendance at these sessions is extremely representative. As an illustration, the drawing session just concluded at Pittsburgh, included men from 31 different states and two Provinces of Canada. They represented 57 different institutions. The attendance was also very evenly distributed by teaching ranks. At each of the sessions we customarily have two or three deans. We have 20 odd full professors, 25 or 30 associate and assistant professors, and an equal number of instructors. So the range of teaching ages and experience is from the oldest and most experienced teachers in our colleges to the young men who have just graduated and who are to take up their teaching work in the fall.

The session about to commence next week at New Haven on civil engineering is perhaps our most elaborate summer school, our most ambitious effort to date. It will be divided into the three principal divisions of civil engineering instruction; structural engineering, sanitary and hydraulic engineering, and transportation engineering, which we are calling railway and highway engineering. There is to be a staff of over fifty men in all, and it will be attended by about 90 teachers.

The drawing sessions, by the way, set the record for attendance with 102.

I might go back just a moment to say that when the summer school was started we had the idea of limiting it to a relatively

small number so that the discussions would be intimate and we could have a small group, all of whom would know one another by the time the session was over. We set a limit of attendance for the first year of 30 at each session. We could not adhere to this and even before the first session convened we had to raise that limit to 40. Now we have simply had to give up the idea of any limitation of attendance. The pressure on us to admit the various men is too great, and it seems unwise to make any discrimination. The result has been that the sessions have increased in number as we go from year to year, from 40 two years ago to 102 at the drawing session this year.

I would like to take this opportunity, Mr. President, to say this: that the summer school has proved the value of coöperative effort in the Society just as its general investigation has. Each of the sessions has been made successful, I believe, by the endeavors of a large group of people, the local directors and secretary, the full-time staff, and the lecturers who are called in from time to time on special subjects. It has been made successful, furthermore, by the splendid spirit of the men who attend. No one can describe it. They would have to be at one of the sessions to understand what I mean. Many of you have attended one of the sessions and perhaps what I am saying is not necessary for you, but I wish the others might at least visit those sessions for a day or two and see something of the vigor with which our groups attack their problems of teaching.

I should perhaps speak of the tentative plans which have been made for next year. When we first began the summer school the initiative in the organization of the sessions came from the Board. It has now passed to the Society membership, and each year we are petitioned to hold sessions on one or more subjects. For next year we have had two such petitions, one originating with the American Institute of Chemical Engineers, that has by action of its governing body requested this Society to hold a session for teachers of chemical engineering. That petition was received sympathetically and approved upon the making of the necessary arrangements. Those arrangements have been started by opening negotiations with the University of Michigan, and through the President and Dean Sadler, the Society has received an invitation to hold the session on chemical engineering at Ann Arbor in the summer of 1931. The University has, incidentally, offered very generous support, financially and otherwise, for that session. I cannot report the final conclusions of the arrangements for the session, however, since we still need to secure some of the funds necessary.

The second petitions were received from the two national mathematical organizations, the American Mathematical Society and the Mathematical Association of America, indicating approval of the

holding of summer sessions for teachers of mathematics by this Society. Again that has been submitted to the Council and approved, contingent upon making the necessary arrangements. I have been in conversation with Dean Leland, of the University of Minnesota during this meeting, since the two societies request us to hold the session at the time and place of their annual convention, which is to be in Minneapolis in 1931. I am hopeful that that session also will come about.

By the end of next year then, we shall have held sessions on eight different subjects of the curriculum, and we shall have pretty nearly reached the place where we can start over again in the summer of 1932 with our original subjects, although there are a number yet to be covered.

Discussion

President Rees: I can certainly testify to one of Professor Hammond's first statements, and that is as to the fine spirit which imbues every one of these summer schools, and the enthusiastic interest which is shown by both staff and student personnel.

Secretary Bishop: Mr. President, I think that this report should be discussed a little in this way: We ought to look forward quite a distant time in the future in regard to the next type of summer schools. I think this would be a good opportunity for an expression from the floor as to what summer schools might be held in the future.

R. C. H. Heck: Having a cycle of about six or seven years it would be a good plan to go around the circle again. There are new men coming in each year and that would make it worth while.

Member: I attended the school at Purdue. I don't see how it could be improved on. Professor Hammond has done a wonderful job. He has so planned the schools that they are almost perfect.

Mr. Hammond: I should like to add to my statement about the summer schools. We should acknowledge very cordially the cooperation that has been given this Society by the National Engineering Societies, the American Society of Mechanical Engineers, the American Society of Civil Engineers, and now the American Institute of Chemical Engineers. It is proper that that should be a matter of record in the proceedings of this meeting.

President Rees: I think through the activity which Professor Hammond is directing, we are coming to a more cordial, sympathetic and active coöperative condition with all of the engineering societies.

REPORT OF DIVISION OF MECHANICS

At this Annual Meeting of S. P. E. E. your newly formed Division of Mechanics makes its first bow. For several years it had been in the minds of some of us that the number of members of the Society interested in the teaching of Mechanics was sufficiently large to warrant the formation of a Division. Last summer your Council acted favorably upon our request, and the new Division took over the work of your former Committee No. 27.

Last June, following the Annual Meeting at Columbus, Ohio, a four-day Conference on the teaching of Mechanics was held, which was attended by 38 men representing 24 different institutions. The discussions in general were very informal, and everyone present took an active part. Many points of view were stated, which after discussion did not prove to be so divergent as they had at first appeared. A brief report of the Conference was published in the Journal of Engineering Education for December, 1929.

At one of the sessions last year, the question was raised as to the percentage of students entering Mechanics who received a condition or failing grade. No one present had definite figures at hand, but estimates from memory varied from 5 per cent to 50 per cent. It was felt that some definite data on the matter would be interesting, and that results over a period of several years should be obtained. We have collected data from five schools, (with more promised), covering the five-year period from 1924 to 1929, and find that in these schools instead of the wide variation from 5 to 50 per cent, there is the much more reasonable variation from 16 to 38 per cent, with an average of 24 per cent. Even this variation would probably be reduced if exactly the same methods of computing percentages were used in all cases. For instance, students who registered but dropped the subject within a short time are counted by some as having failed, but by others are not counted at all.

We judge from these results, and also from the quality of preparation of students who transfer from other schools with partial credit, that the standard of achievement required in the different schools is very much the same.

An attempt was made also to obtain some data on the correlation of the individual student's grades in mathematics and physics with his later grades in mechanics, but on account of the difference in courses and in methods of grading at the different schools, no comparison of results was considered feasible. A paper written by Professor W. B. Sanders of Purdue and presented at our Confer-

ence here Thursday morning gives the results at Purdue. Valuable use has been made of this study at Purdue, and decisions on all cases involving admission to Mechanics without the full prerequisites are always based upon the student's previous record. The chief difficulty in administration consists in persuading each student who is refused admittance to the course that his case is not one of the glowing exceptions to the rule.

Respectfully submitted,

G. P. BOOMSLITER,
J. E. BOYD,
E. R. MAURER,
C. E. PAUL,
E. W. RETTGER,
N. C. RIGGS,
LEROY TUCKER,
S. M. WOODWARD,
A. P. POORMAN, *Chairman.*

THE T-SQUARE PAGE

By FREDERIC G. HIGBEE
University of Iowa, Editor

As an outgrowth of the conferences on engineering drawing held at the annual meetings of the Society for the Promotion of Engineering Education at Cornell University in 1923; at the University of Colorado in 1924; at the University of Iowa in 1926; and at the University of Maine in 1927; the division of engineering drawing was organized and authorized by the Council at the Chapel Hill meeting of the Society in 1928. At all these meetings, teachers of drawing and descriptive geometry felt that many of the problems which were presented for discussion could be more fairly digested and put into form by committees assigned to the task of studying the many points raised in the conferences. Consequently, at the Chapel Hill meeting the organization of the division of drawing was perfected and an executive committee was appointed to set up an organization which would function along the lines indicated by previous discussions.

Immediately following the Chapel Hill meeting a committee on engineering drawing with Professor H. M. McCully of the Carnegie Institute of Technology of Pittsburgh as chairman; a committee on descriptive geometry with Professor William G. Smith of Northwestern as chairman; a committee on research with Professor C. V. Mann of the Missouri School of Mines as chairman; and a committee on summer session with Professor F. G. Higbee of the State University of Iowa as chairman were appointed. The executive committee was composed of seven members with Professor Thomas E. French of the Ohio State University as chairman and Professor R. P. Hoelscher of the University of Illinois as secretary.

The reports of these four committees formed the basis of the first meeting of the division of engineering drawing at the Columbus meeting in 1929. Not only the reports themselves but the general discussion which followed justified the belief that engineering drawing teachers would have a common interest which when properly directed would result in productive and interesting work.

Later issues of the JOURNAL will contain abstracts of the reports submitted by these committees and an outline of research projects now begun. As a direct result of the report of the committee on summer session, with its accompanying recommendation to the Council of the Society, the request of the engineering drawing

division was granted and a summer school for engineering drawing teachers was put upon the program of the Society for the summer of 1930. One of the important by-products of the 1930 summer school for drawing teachers was the general agreement of those attending that a page in the JOURNAL devoted to the interests of the engineering drawing teachers would be desirable. In accordance with this expressed opinion a recommendation from the summer school was presented to the engineering drawing division at the Montreal convention in 1930 and the division unanimously agreed to request the editor of the JOURNAL for a page. This page, it was agreed, was to be known as the "T-Square Page."

In accordance with this action the editor has reserved a page in this JOURNAL which hereafter will be known as the "T-Square Page." In the course of time it is hoped a suitable design may be printed at the top of the page which will be indicative of the nature of the page and the interest it serves. At the meeting of the executive committee of the engineering drawing division following the Montreal meeting, Professor Frederic G. Higbee of the University of Iowa was appointed editor and from this date each issue of the JOURNAL will contain "The T-Square Page" devoted to the interests of teachers of engineering drawing, descriptive geometry and related subjects.

THE 1930 SESSIONS OF THE S. P. E. E. SUMMER SCHOOL FOR ENGINEERING TEACHERS

By H. P. HAMMOND, *Director*

The two sessions of the Society's Summer School, of 1930, were the best attended and in many respects the most successful thus far held. Eighty-eight teachers enrolled in the civil engineering session, held at Yale University from July 1 to 23 inclusive. The staff numbered fifty-two. The session on engineering drawing and descriptive geometry, held at the Carnegie Institute of Technology from June 12 to 21 inclusive, was attended by ninety-nine teachers, with a staff of twenty members.

Both sessions were remarkable for the widely representative nature of the attendance. The members of the civil engineering session came from twenty-seven states, two provinces of Canada and one foreign country. Sixty colleges were represented. At the drawing session thirty-three states and provinces of Canada and fifty-seven different institutions were represented. The attendance was also remarkably representative of the various teaching ranks, the two sessions taken together including three deans, fifty-eight professors, thirty-six associate professors, fifty-three assistant professors, thirty-six instructors and one assistant, these numbers being nearly proportional to the total numbers of teachers of these ranks in engineering colleges. Since the establishment of the summer school in 1927 there has been a shift in the age and rank of those attending from the younger to the older men, the sessions of 1930 having a strikingly larger representation from the higher teaching ranks than did the early sessions of the school.

It is not possible within the limits of a short article to give an adequate picture of the work of the two sessions and but a few of their more important features can be mentioned. One of the most characteristic features of the session on engineering drawing and descriptive geometry, aside from the excellence of the lectures by staff members, was the number and quality of the prepared discussions presented by members of the group. These discussions, together with the formal lectures themselves, gave a summary of practices and of points of view on the more important phases of instruction in drawing and descriptive geometry that represented nearly, if not indeed quite, the entire range of practice in American institutions and thus gave the members a comprehensive view of their field of work as well as a summary of the methods of the ablest

THE CIVIL ENGINEERING SESSION OF THE S. P. E. E. SUMMER SCHOOL FOR ENGINEERING TEACHERS, YALE UNIVERSITY, JULY, 1930.

THE ENGINEERING DRAWING AND DESCRIPTIVE GEOMETRY SESSION OF THE SUMMER SCHOOL FOR ENGINEERING TEACHERS, JUNE, 1930.

teachers of their subjects. Lectures by engineers and chiefs of drawing divisions of industries similarly presented a view of drafting and design practices which formed a valuable supplement to the discussions of teaching and furnished a correlation of methods of instruction with the requirements of actual engineering methods.

A further feature of the drawing session was an excellent series of inspections of Pittsburgh industries, with special reference to their drawing and design departments, illustrating how the principles of drafting and design as well as the organization of those departments are actually carried out in practice.

At the conclusion of the session a dinner was held with Dean Gardner C. Anthony as the guest of honor. As in others of these concluding summer school dinners, which have become a regular feature of the sessions, the members "broke training" by songs, "stunts," and general good fellowship.

Undoubtedly the most outstanding feature of the civil engineering session was the size and the quality of the teaching staff. Included among its members were some of the ablest teachers and practicing engineers of the profession; the roster, in fact, reads much like a section of "Who's Who in Civil Engineering." The present president and most recent past president of the American Society of Civil Engineers, Mr. John F. Colman and Dean Anson Marston, respectively; Deans F. E. Turneaure, Richard G. Tyler and C. C. Williams; Professors J. C. Tracy, J. K. Finch, H. F. Moore, Charles M. Spofford, George E. Beggs, A. H. Fuller, W. K. Hatt, Clyde T. Morris, Francis P. Witmer, Charles M. Allen, Gordon M. Fair, Elton D. Walker, S. M. Woodward, Thomas R. Agg, and R. L. Morrison, to mention only a few, were included. Engineers from the field of practice on the staff included such men as Alfred D. Flinn, Director of Engineering Foundation, F. R. McMillan and H. F. Gonnerman, respectively Director of Research and Laboratory Manager of the Portland Cement Association, A. G. Bruce, Engineer, U. S. Bureau of Public Roads, Samuel Eckles, Chief Engineer, Pennsylvania State Highway Department, Thaddeus Merriman, Chief Engineer, Board of Water Supply of New York City, George B. Ford (since deceased), Director of the Regional Plan of New York, William Bowie, Chief, Division of Geodesy, U. S. Coast and Geodetic Survey, Michael I. Pupin, Leon S. Moisseiff, Consulting Engineer to the Port of New York Authority, and Messrs. E. P. Goodrich, Charles S. Whitney, O. E. Hovey, Clarence W. Hudson, Frank P. McKibben, D. B. Steinman, J. A. L. Waddell, William P. Creager, T. Chalkley Hatton, Robert S. Weston, Maxwell Halsey, Arthur G. Hayden, and Fred Lavis, whose names are so well known in civil engineering as to need no comment.

Of special interest at the civil engineering session was a series

of lectures and discussions of educational principles and practices conducted by Professor Francis T. Spaulding of the Graduate School of Education of Harvard University. These lectures, or a portion of them, will appear in subsequent numbers of the JOURNAL.

Another feature of the session, provided as a means of having the large group become well acquainted early in the session as well as for other reasons, which proved both enjoyable and instructive, was a stay of three days at the Yale Engineering Camp at East Lyme, Connecticut. There the members renewed their acquaintance with the life of the civil engineering camp, lived in barracks, swam in the lake, held a "regatta," played baseball, pitched horse shoes, sat around camp fires, swapped yarns and in other ways thoroughly enjoyed themselves. During the stay at the camp the portion of the formal program devoted to organization and methods of teaching courses in surveying both in the field and in the classroom was carried out.

The programs of the two sessions of 1930 differed, each being adapted to the needs of the group and of the division of the curriculum under discussion. That of the drawing session was arranged in but one division common to all the teachers attending. It included, in order of presentation, study of the aims and purposes of courses in engineering drawing and descriptive geometry, content of these courses, methods of administration, principles and methods of teaching, examinations and tests of achievement and other similar topics. These were supplemented by lectures on the applications of the principles of drawing and descriptive geometry in practice, drafting standards, the history of graphic representation, and by inspections of drafting and design practices in industry. Included in the program were also the work and reports of a number of committees of members of the group on aims and purposes of drawing courses, methods of instruction, tests of achievement and other subjects.

The program of the civil engineering session was arranged in two principal parts: one, common to all in attendance, was devoted to educational principles and practices, history of civil engineering, surveying, materials of construction, professional ethics, business relations of the civil engineer, the teaching of personnel administration, and other topics of interest to all teachers of civil engineering. The remainder of the program was divided into three parts, or divisions, devoted respectively to structural engineering, sanitary and hydraulic engineering, and highway and railway engineering. These divisional meetings were attended by teachers of the subjects mentioned. Methods of instruction and content of subject matter were discussed in greater detail both by staff and group members in these divisional meetings.

No written statement about the summer school sessions can convey an idea of their most important aspect: the spirit of earnestness and of enthusiasm with which those present entered into the work. At both sessions this spirit was maintained unabated until the very end.

A number of trips of inspection to nearby engineering works, including certain notable projects in New York City, and other trips of general interest were arranged as part of the program. Among these was an inspection of the battleship Mississippi, on invitation of the U. S. Navy Department.

At both the drawing and the civil engineering sessions a number of the members and of the staff were accompanied by their families. Receptions and other entertainments were arranged for the ladies of the groups by the families and the officers of the local faculties.

At Pittsburgh the group was quartered in dormitories of the Carnegie Institute of Technology; at Yale the Vanderbilt Sheffield Dormitories were set aside for the summer school. In both instances the accommodations were splendidly adapted to the needs of the members.

The drawing session was under the direction of William E. Mott, Director of the College of Engineering, Carnegie Institute of Technology, Local Director, Professor H. M. McCully of the same institution, Secretary, and Thomas E. French of Ohio State University, Chairman of the Teaching Staff. The staff of the civil engineering session was headed by John C. Tracy, Professor of Civil Engineering, Yale University, Local Director, and Roscoe H. Suttie of the same institution, Secretary.

Publication of a number of the papers presented at the two sessions of the summer school begins in the present number of the "Journal," and will continue in subsequent issues. These papers will also be printed, as in the past, as separate monographs and will be available for quantity distribution by addressing the office of the Director of the S. P. E. E. Summer School, 99 Livingston Street, Brooklyn, N. Y.

ANNOUNCEMENT OF THE SESSIONS OF 1931

By action of the Society's Council at the Montreal meeting, invitations of the University of Michigan and of the University of Minnesota for the holding at those institutions, respectively, of sessions of the summer school on chemical engineering and on the teaching of mathematics to engineering students were accepted, contingent upon the completion of financial and other arrange-

ments. Final announcement concerning these sessions as well as details as to dates, programs, members of the staffs and other matters will be published in subsequent numbers of the JOURNAL. It is probable that the session on chemical engineering will be held immediately after the Society's annual convention, to be held at Purdue University in June, and that the session on mathematics will be held in the latter part of August immediately preceding the dates of the annual meetings of the American Mathematical Society and the Mathematical Association of America both of which are to be held at Minneapolis.

While no limit will be set on the attendance at either of these sessions except as may be necessary by reason of the accommodations available, it is advisable for teachers who may expect to attend to make early reservations. This may be done by addressing a letter stating the institution and teaching rank of the applicant to the Director, S. P. E. E. Summer School, 99 Livingston Street, Brooklyn, N. Y.

THE ENRICHMENT OF EXPERIENCE IN THE DEVELOPMENT OF THE TEACHER *

By JOHN C. TRACY

Professor of Civil Engineering, Yale University

I am to speak on "The Enrichment of Experience in the Development of the Teacher." By *experience* I mean more than teaching experience, more than practical experience,—I mean the *sum total* of a man's personal experience. By *enrichment* I mean more than the mere broadening of experience, more than the deepening of experience,—I mean all that enrichment implies.

I shall remind you how inevitably and vitally experience affects our thinking, our personal qualities, and our influence as teachers, and I shall try to state some of the most important guiding principles that we should follow in seeking to enrich our experience.

Experience is only in part a matter of age. One man may gain a richer experience in a few years than another may acquire in a lifetime. Nevertheless, my message, if I have any real message, is intended primarily for the younger men. The thoughts that I bring to you are neither new nor original, as you will see, but it is my hope that the total effect of what I say may be to influence some of you to seek early in life that enrichment of experience which some of us have gained needlessly late in life, if at all. My old teacher, Professor DuBois, used to say: "Good advice from a bad man is worth something." On this principle, if on no other, an older man may venture to speak to younger men on the general subject of experience.

Let us begin by thinking about thinking, particularly the effect of experience on thinking. We are constantly storing up in our mind images and concepts which our senses bring to us; we are continually adding to the picture gallery of our imagination mental photographs formed by exposures to all sorts of experiences. These images or concepts constitute the thought material upon which our mind works in reflective thinking or in meeting new experiences. Thinking does not consist merely in recalling this thought material, but thinking cannot proceed without it.

Much of our thought material is second-hand in the sense that it is gained through the experience of others. When, for example, an object or an emotional experience is pictured or described to us,

* A lecture delivered at the Civil Engineering Session of the S. P. E. E. Summer School for Engineering Teachers, Yale University, July 14, 1930.

we add a new image or concept, and this addition is in itself a first-hand experience, but the image or concept is second-hand, because it is not the result of direct contact with the object or the emotion itself. The important distinction between first-hand and second-hand thought material is too frequently overlooked or forgotten, not only by teachers, but by many others interested in education.

The experience of an individual is so limited that much of his most important thinking, particularly abstract thinking, must necessarily proceed from second-hand thought material. Rational knowledge of such things as mathematics and the sciences, indeed abstract conceptions of all kinds come to us through the cumulative experience and thinking of the ages. But in this discussion I am mainly concerned with the fund or store of experience and facts, of images and concepts that we gain first-hand. I have been speaking of this thought material as a sort of building material from which we construct our thoughts. A building is the product of certain processes of construction applied to building materials. It is possible and often desirable to discuss many of the effects of building materials on methods of construction and upon the building itself without going deeply into the technical methods of construction. Similarly it is possible to discuss some of the important effects of thought material on thinking and upon the results of thinking, without going deeply into methods of thinking, and this is what I now purpose to do. May I ask you to remember, therefore, as I proceed, that I am not discussing primarily *methods* of thinking, but rather the effects of our thought material upon our thinking and upon ourselves.

FUNDAMENTAL FACTS AND PRINCIPLES PERTAINING TO THOUGHT MATERIAL

There are certain familiar facts and principles pertaining to thought material that are so fundamental that we shall need to keep them in mind throughout this discussion.

First Fundamental: Images and Concepts Gained from Experience are Real to Us.—Let me illustrate. The man who habitually lives in a city gains from experience all sorts of images of a city and its life which are *real* to him, but his images of a wilderness are usually vague and unreal. The sailor's image of the sea is *real* but his image of a desert is not. The man in the tropics has a vivid conception of a hot climate but very little conception of a cold climate. These illustrations will suffice to show what I mean when I say that first-hand thought material gained from experience is real to us.

Second Fundamental: Experience Modifies or Changes Much of Our Second-hand Thought Material.—The images and concepts gained from experience not only modify and vivify images and concepts that we have acquired second-hand, but they also change much of our second-hand thought material to first-hand material. To realize the truth of this we have only to compare our image or concept of *any* sight, sound, smell, taste or feeling before and after experiencing it, or to compare our concept of any experience before and after we have had it. For example, I may have a fairly correct image of the Capitol Building at Washington before I have seen it, but my first sight of that building will surely modify and vivify my image, or I may *think* I have a correct concept of teaching before I have taught, but the experience of teaching will almost inevitably change my concept and continue to change it as long as I teach.

Third Fundamental: Much of Our Best Thought Material Can be Gained Only through First-hand Experience.—I am thinking here not of rational knowledge and abstract conceptions, but more particularly of our acquaintance with the world of material things and of our conceptions that have to do with personality, character and the fulness of a man. The truth and importance of this second fundamental will become clear from one or two simple illustrations. No one is ever fully prepared for his first sight of the Grand Canyon of Arizona, no matter how many descriptions he may have read or pictures he may have seen of this great natural wonder. The moment he stands on the rim his whole conception of the canyon is changed. Awed and overwhelmed by its grandeur and beauty, he instantly gains an image that ever more will enrich his thinking. When he attempts to convey this image to another, he realizes how helpless he is to describe or picture the Grand Canyon. What is true of this great canyon is true of much in nature all about us. Adequate images or concepts of mountain and plain, river and sea, sun and moon, thunder and lightning, sunset and sunrise are gained only from direct experience. A similar assertion can be made concerning a great variety of images which our senses bring to us. It is true also that adequate concepts of deep emotions are acquired only through experience. One has no adequate concept of sorrow, for example, until one has suffered a great sorrow; or of joy, until one has experienced a great joy. Thus it is that in the natural world and in the spiritual world alike, experience is often not merely the best teacher, it is in fact the *only* teacher.

Fourth Fundamental: We Gain Our Thought Material Largely in Accordance with Our Likes and Dislikes, and as We Extend Our Experience We Multiply Our Likes and Dislikes.—When we like or dislike anything we are interested in it and when our

mind is exposed to images and concepts which interest us, the impressions are likely to be clear and lasting. We are not likely, however, to gain much from experiences which do not interest us because our mind is not spontaneously active in acquiring thought material to which we are indifferent. By increasing the variety of our experiences we may increase our likes and dislikes and thus the variety of our interests.

Fifth Fundamental: The Quality of Our Thinking Depends upon the Quality of Our Thought Material.—It depends also upon methods of thinking, but we are not concerned here with these methods. This fifth fundamental may seem a mere platitude, but it may be well to discuss just how experience by improving the quality of our thought material improves the quality of our thinking. (*a*) Experience by making our thought material real to us vitalizes our thinking. What is real to us interests us, and what interests us stimulates our thinking. (*b*) Experience broadens and tempers our thinking. As we add to the variety of our experiences we multiply our likes and dislikes and consequently our interests and our thought material. We thus increase our capacity for thinking broadly. Provincial thinking is, of course, due largely to limited experience. As we broaden our experience we tend to become more open-minded and tolerant. The more we extend our experience, the more we realize our own limitations. We thus gain a genuine humility that tempers and regulates our thinking. (*c*) Experience clarifies and corrects our thinking. A prime requisite for clear thinking is a clear mind; the clear images and concepts gained from experience contribute greatly to this quality of mind. Moreover, experience corrects our thinking. A man in the business world who thinks incorrectly rarely escapes the consequences—he is likely to suffer; but this is not always true of a man in academic life. Unless we have some of the corrective checks which experience outside the college almost inevitably produces, we may for a long period of time have a mistaken conception without getting hurt. As our experience clarifies, broadens and tempers our thinking, however, we gradually replace our misconceptions and prejudices by truer and more exact images and concepts and thus correct our thinking.

The gist of the whole matter is that experience by enriching our thought material enriches our thinking. This is the principal underlying thought in my whole discussion.

Sixth Fundamental: We Inevitably Reveal by What We Say, by What We Do, and by Our Attitude toward Life the Quality of Our Thought Material.—The emphasis here should be on the inevitableness of the self-revelation. It is so easy to reveal unconsciously the quality of our images and concepts! Indeed the

quality of a man's thought material pertaining to a given subject is often revealed by his spontaneous reaction to a single word. What, for example, is a man's spontaneous reaction to the word "war?" This sixth fundamental has a direct and important relation to the influence of a teacher, as I shall try to show later.

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I have spoken thus far as if experience inevitably improves our thinking. This of course is not true. Experience may be detrimental to thinking. For example, the broadening of experience may lead to an indecisive openmindedness, a weak vacillation in thinking. Too intense or too prolonged an experience may leave one embittered, cynical, and prejudiced. Association with others in mass thinking may mean loss of independence in thinking. The effect on our thinking of any experience depends, first on how well we are prepared to meet that experience, and, second on our methods of using the thought material which we gain. In general, however, the normal effects of experience on thinking should be highly beneficial, and it is with these normal effects that we are here concerned.

It may be well at this point for me to emphasize again the fact that I am not discussing methods of thinking. Such a discussion would lead us away from our main thought which, may I repeat, is merely this: That if our thinking is to be of high quality our thought material must be of high quality, and that it is possible through varied experience constantly to improve the quality of our thought material. Thinking depends more upon experience—upon the possession of rich, pregnant thought material—than we are frequently led to suppose. We may actually nurture the mind by providing it with the best food for thought—not merely by reading and study, but through first-hand experience.

I have summarized some of the more important effects of experience upon our thought material and upon our thinking in order that we may study these effects in connection with the interplay of thought between teacher and student. Some teaching has been described as merely the process of getting information from the notebook of the teacher to the notebook of the student without it passing through the mind of either. But assuming that the minds of both teacher and student are active, how is this activity affected by the accumulated experience of each? I shall speak only briefly of the student, more at length of the teacher.

THE STUDENT AND HIS EXPERIENCE

We too often forget that the student's appreciation or lack of appreciation depends upon his own first-hand experience. This is

true in every subject that he studies. Let us take, for example, English literature. In Whittier's "Snow Bound" occur these lines:

"No cloud above no earth below
A Universe of sky and snow
The old familiar sights of ours
Took marvelous shapes, strange domes and towers."

Only a student who has experienced a hard snow storm can visualize fully the scene thus depicted, or can appreciate what it means in Whittier's words to "cut the solid whiteness through."

Let us take as another example Tennyson's "Crossing the Bar" which begins:

"Sunset and evening star
And one clear call for me,
And may there be no moaning of the bar
When I put out to sea."

Students frequently vote this as their favorite poem; why I do not know. It surely is not because its theme is death, for that is generally remote in the mind of the student, nor is it merely because of its beauty of expression. Is it not, perhaps, because all through the poem there is a manly ring of *courage* that challenges death, and *courage* is something students appreciate from their own experience.

Let us take another example, the single phrase "He who seeketh his life shall lose it." Few men at the beginning of life can appreciate the profound significance of this paradox. It takes us a life time of experience, in which we try at first the more selfish pursuit of life and happiness, to convince us that we *really* must lose our life to find it.

These examples indicate that the student necessarily interprets what he reads or hears in terms of his own experience—his own images and concepts. When these images or concepts are inadequate there is a lack of appreciation which results in a lack of interest. I have in mind a series of excellent lectures given by practicing engineers to a class of earnest students in engineering. In the discussion periods that followed the lectures it became evident that the students did not appreciate and were not interested in many of the most important portions of these lectures, probably because of their lack of experience not only in engineering but in life itself. We teachers never quite cease to be surprised that reading and study and lectures fail to do for the student all that we expect. We can teach the student *methods* of thinking, but we cannot teach him to think. We forget that the student's mind cannot work on images and concepts which he does not possess and

cannot obtain except through first-hand experience. We are disappointed because the student does not have thought material which it has taken us years of experience to acquire.

THE TEACHER AND HIS EXPERIENCE

Let us turn now to the teacher and his experience, not merely his teaching and his practical experience, but his whole life experience. Let us consider the effect of experience on the teacher's thinking, on the teacher himself, and upon his influence.

Effect of Experience on the Teacher's Thinking.—In accordance with principles previously stated, the quality of our thinking depends largely upon thought material gained from experience and *only* from experience. We have seen how such thought material may vitalize, broaden, temper, clarify, correct, and enrich the teacher's thinking. It enables him to eliminate from his thinking the trivial or unimportant; when experience has been great enough to make one big-minded he has no time for non-essentials. It creates a cosmopolitan mind. It also creates a colorful and vivid mind and hence a corresponding capacity for statement. A wide experience in the range of human situations enables the teacher to put things in terms real to the individual. Experience helps the teacher to think more spontaneously and less self-consciously—a most important gain because his best thinking is done when he is not conscious of it.

Effect of Experience on the Teacher Himself.—It is questionable whether we are justified in separating the effect of experience on the teacher's thinking from its effect on the teacher himself. "As a man thinketh so is he." There are, however, certain effects, which, though the direct result of thinking, become manifest in the behaviour of the teacher. Experience enables the teacher gradually to find himself. If, on the one hand, he has an inferiority complex, experience brings to him thought material of such varied and intense interest, that thought of self is expelled and diffidence gradually disappears. If, on the other hand, he has a superiority complex, experience begets a genuine humility and an openminded, receptive attitude toward all truth. It tends to eliminate pretense and academic pose. It checks the tendency to ideals of impossible perfection, and helps in other ways to maintain a mental balance. Experience enables the teacher to speak with authority because he is dealing more frequently with first-hand images and concepts. What he says is more readily accepted. Finally, experience tends to make the teacher more alive and dynamic with personal power and magnetism, because he is more open to life all about him and because life abundant comes from the enrichment of experience.

Effect of Experience on the Teacher's Influence.—All of us will agree that nothing is more important in education than the influence of the teacher in helping the student to develop methods of thinking, methods of work, and the personal qualities that enter into a fine character. Each of us can think of some teacher of influence who was a constant source of inspiration. To sit under a great teacher of this sort is in itself a liberal education no matter what subject he teaches.

Every teacher has an influence for better or worse whether he knows it or not and whether he desires it or not. The teacher is no exception to the general rule that a man will inevitably reveal by what he says, by his attitude toward life and by his own life the quality of his thought material. Students are as quick to appraise him by such revelations as by his knowledge of the subject that he teaches.

A genuine and enthusiastic interest in the student is assumed as part of the passion for teaching, without which no teacher can have the right kind of influence. But interest and good intentions alone are not sufficient. The teacher must have an abundance of thought material upon which his mind may work naturally and easily. Influence cannot be pumped from a teacher into a student, it must flow naturally and unobtrusively. Someone has said that "influence is the effluent of affluence." One interpretation of this epigram is that influence flows naturally and spontaneously from a reservoir of thought material which has been gradually stored up from a wide and varied experience. The teacher can give out nothing that he does not have, nor can he help giving out that which he does have. Let him vitalize, broaden, clarify, temper, and enrich his thinking by enriching his experience and his influence will perforce become proportionately greater.

THE ENRICHMENT OF EXPERIENCE

I have discussed at length the effect of experience on our thought material, on our thinking, on our personal qualities and on our influence. I wanted to show in a clear and definite way how essential—how very essential—the enrichment of experience is in the development of the teacher. It now remains for me to suggest *how* we may enrich our experience. This is far more difficult, because, for the most part, each of us must solve this problem for himself. It may be possible, however, to state some of the more important guiding principles.

GUIDING PRINCIPLES IN ENRICHING EXPERIENCE

Cultivate a Thorough Appreciation of the Importance of Experience.—The more we realize the possibilities of the enrichment

of life through the enrichment of experience the more likely we are to have that constant motivating desire which leads us to seek experience. Such a desire is marked by an eager curiosity which, judiciously cultivated, will result in both broadening and deepening our experience. We appreciate the importance of teaching experience and practical experience, but we do not always appreciate the importance of other experience. We must if we are to seek it. If we only care enough about experience we shall certainly attain it.

Seek First Those Experiences in Which You are Interested.—In discussing the effect of experience on our thought material I stated as a fundamental principle that the nature of the thought material which we store up depends largely on our likes and dislikes, and that the mind is not spontaneously active in acquiring thought material to which we are indifferent. We are sure to concentrate on that in which we are interested, whether we like it or dislike it. Moreover, the surest and perhaps the only way to acquire a new interest is to associate it with an old interest. In seeking to enrich our experience we are likely to make the mistake of beginning with some experience in which we have no real interest but in which it is considered to be the proper thing to be interested. How much time we all have wasted, for example, in trying to admire what others consider admirable. It is better, at least at first, to find our own vein in which our richest interest lies and from which we may gain thought material that is real and vital to us. The investigator who has the flair for research and who is working in a field in which he is greatly interested finds that his quest after truth is not drudgery but fascinating work. So it should be in the quest for experience. Do not misunderstand me. We cannot and should not always follow our inclinations. There are certain experiences that every man should seek whether he is interested in them at first or not. But if we start on the quest for experience in something in which we are interested and follow the quest with eager curiosity, we are sure to be led into strange areas in which we find new interests of which we had not dreamed. Nor should we forget that many of life's richest experiences are those we do not like and would not seek, experiences like extreme physical hardships, bitter disappointment, intense pain, and deep sorrow. Such experiences test and develop our whole manhood. Although they come to all of us unsought, they are of such vital interest that they leave vivid and unforgetable impressions—images and concepts—that enrich our thought material and hence our lives. But we are more concerned now with those experiences which we deliberately seek. Again may I repeat, we should seek first those experiences in which we are interested, but not without the hope and expectation that they will lead to others in which we may become interested.

The extent to which the whole circumference of our experience is thus gradually enlarged is a measure of what we get out of our experiences.

Seek Experience for its Own Sake and Not Primarily Because it may be Useful.—There is a real danger in seeking experience for a definite purpose, such, for example, as to improve our teaching. In the first place, this kind of seeking is likely to result in an habitual effort to impress others with our experience. To be everlastingly conscious of our experience begets a constant temptation to show off before students, a form of egoism and egotism that is fatal to a teacher's influence. In the second place, the man who seeks experience in order to retail it to others is not free to keep emotionally wide open to those new impressions—new images and concepts—that are most enriching. Experience should be gained not so much from conscious effort as from habitual exposure. Disinterestedness in seeking experience paradoxically increases interest, and from this increased interest come new images and emotions that are not as freely acquired if at all, by conscious effort. It we wish to be mentally prepared for the enriching effects of any experience we should try to free ourselves from egoistic preoccupation about the results of that experience.

Seek a Well Rounded Experience and Realize that Seeking it Means Work.—This may seem inconsistent with the second and third guiding principles that I have just stated. In the first place, how can we seek a well rounded experience if we seek only those experiences in which we are interested? You will remember that what I advised was to *begin* with experiences in which we are interested as the surest way of approach to those in which we are not. In the second place if it means hard work, how can we expose ourselves to experience without a definite purpose and without conscious effort? There is a distinction between having an underlying purpose and letting that purpose intrude upon our consciousness during an experience, and there is also a distinction between working in order to gain an experience and making work of an experience. We may, for example, have a definite desire or purpose to enrich our experience by traveling, we may make a determined initial effort in order to travel, and we may be compelled to work while we travel, but if we are constantly keyed up to our purpose and are continually conscious of effort, we shall miss much of the enrichment that we desire. In seeking any rich experience, we need to confine our ambitions, our anxieties and our conscious efforts as far as possible to our general purposes and plans, and then, in the words of William James, to "*unclamp* our intellectual and practical machinery and let it run free." Thus relieved from inhibitions, the mind is sensitive to the impressions brought to it

by the experience, much as the camera film is sensitive to the images brought to it by the lens. We need to avoid, on the one hand, the danger that comes from seeking experience for a definite purpose and through conscious effort, and, on the other hand, the danger that lies in the failure to seek experiences in which at first we are not interested.

METHODS OF ENRICHING EXPERIENCE

I shall not dwell long on methods of enriching experience. The principal thing is to have a constant and eager desire for such enrichment. If I have stimulated to some degree such a desire my main purpose is accomplished. Having that desire, each of us can analyze his own experience and seek to enrich it. No two of us could or should follow exactly the same methods. It is a personal problem on which each individual, as long as he lives, must be continually working. I shall, however, suggest briefly several general sources of experience that may be helpful.

Contact with Men.—I place first, as possibly the most important, contact with men. Much of a teacher's time is spent with men younger than himself, whose thought material, for the most part, has not been gained from first-hand experience. We peculiarly need to talk with men of varied experience, particularly men outside our own teaching and engineering professions. Most of us, I think, find it interesting to talk with all kinds of men with different points of view, rich and poor, educated and uneducated, reasonable and unreasonable, workers and loafers, Americans and foreigners. If we have such an interest and follow it habitually, it will bring to us thought material of unbelievable variety, rich in new images and concepts.

Volunteer Civic Service.—A second general source of experience is volunteer civic service. Mr. Hoover has said that: "Engineers should exert themselves in our national engineering policies or the next generation will face a lower instead of a higher standard of living than ours." As an individual, each of us may feel rather helpless to respond to this challenge of Mr. Hoover's, but we can at least begin by exerting ourselves in volunteer service for the community in which we live, not merely in engineering policies, but in any form of civic work for which we are fitted. This is not only a duty, it is an opportunity. If we assume our fair share of civic responsibility in our own community, we shall, first of all, be brought into contact with all kinds of men, as I have just advocated. In addition, we shall gain first-hand experience that is likely to modify or entirely revise many of our ideas. To serve on a city council, a city commission, a board of education, or some other

municipal body is an experience that brings new concepts of problems in government. To serve as a member of a chamber of commerce, a service club, a community chest, a welfare organization, or some other good civic organization is an experience that brings new concepts of community problems and civic responsibilities. Volunteer civic service involves work but it may become fascinating as play. It is its own reward—not merely in the satisfaction that it brings, but also in the abundant thought material that it inevitably produces.

Travel.—A third general source of experience is travel. Even the most unobserving is bound to acquire new images and concepts when he travels. Moreover, travel affords one an opportunity to come in contact with all kinds of people. The value of travel is greatly lessened, however, when one merely rushes from place to place with no intelligent curiosity and with little thought. On the other hand when one travels with too conscious an effort to inform himself, he may lose much of the benefit he should obtain. Here, as elsewhere, the best experience is gained by exposure rather than by conscious effort.

Recreation.—The fourth source of experience is recreation. We are too prone to think of play as a waste of time, or, at best, as a means of healthful exercise. But play is much more than this, it brings to us some of our richest experiences. Every teacher should have at least one hobby and the essence of a hobby is that it shall be play, not work. Our hobbies, if followed far enough, will lead us to all sorts of new experiences, and a single hobby, such for example as fishing and camping, may be an experience that is a liberal education in itself.

I have ventured to suggest these four general sources of experience not because they are necessarily the most important, but merely to stimulate your own thinking on the practical side of this discussion. Anyone of us could continue indefinitely to think of various methods of gaining a varied experience and, as already stated, the seeking of such an experience is a problem that each individual must work out for himself. Moreover, may I again remind you that if we constantly have a mental welcome for new images and concepts and if we continually expose our mind to such new impressions, rich experiences pleasant and unpleasant will come to us unsought.

DIFFICULTIES OF ENRICHING EXPERIENCE

Some of you may be thinking of the many serious practical difficulties which I have seemingly overlooked. Where can a teacher get the necessary time or money or both with which to seek this

varied experience? We engineering teachers have already an almost impossible task. We are members of two professions, teaching and engineering, either one of which could occupy our whole time. When we are young we must work hard and continuously to make good. When we are older, responsibilities come pressing in on us and fill our lives to overflowing. The incomes of most of us are relatively small. There are so many things which we should like to do to enrich our experience, but we seem bound hand and foot. All this I must admit. We cannot afford to seek the experiences that we desire, yet we cannot afford *not* to seek them. In the face of these difficulties may I suggest, however, some mitigating conditions:

(*a*) The nature of the engineering subjects that we teach and of the engineering work that we do in connection with research or with teaching compels us to maintain outside contacts. In this respect we are more fortunate than many college teachers.

(*b*) Some of the best sources of experiences, such as contact with men, volunteer service, and recreation, are open to us in the community in which we live and often without expense.

(*c*) Travel may seem expensive and difficult especially with a wife and small children, but it is now possible for one to take his whole family in his automobile and gradually cover all sections of our country at a cost not much if any in excess of the cost of living at home. Hundreds of workingmen on small incomes are doing this and so can we.

(*d*) There never was a time when it was so easy to gain new images and concepts. Modern methods of photographing and projecting, of recording and reproducing bring us sights and sounds from all parts of the world. In spite of the trash that at present makes up so large a part of the movies and of the radio, we are able to see vividly pictured places and peoples that we could not visit, and to have reproduced marvellously fine music and important speeches that otherwise we could not hear. Never before has there been such easy access to parks, gardens, exhibits, theaters, museums, lecture halls, libraries and numberless other agencies for bringing us new images and concepts. Moreover, the very complexity of life all around us affords unprecedented opportunities for acquiring new thought material of great variety and importance.

But when all is said and done, it must be admitted that to enrich our experience is no short, easy undertaking—it is a long, difficult achievement. But, as I have said, experience comes not so much from constant effort as from an eager desire to expose oneself to a great variety of enriching experiences. If this desire is sufficiently strong, we shall find a way to satisfy it.

I have now covered the most important part of my subject. I have tried to explain the effect of experience on our thinking, to emphasize the need of varied experience, and to suggest how we may expose ourselves to such experience. I would be inclined to stop here did I not feel that I might be misunderstood and my message weakened by the seeming omission of what is commonly considered the two most important educational experiences. It seems necessary that I should say something about the educational experience that we obtain through reading or study, and the cultural experience that we gain through exposure to cultural influences.

READING AND STUDY

You may be surprised that I have not included reading and study as a means of enriching experience. Surely, if we are to benefit by the accumulated experience of all men, if we are to carry with us into the future the lessons of the past, if each generation is not to start all over again we must read and study. Moreover, reading and study *prepare* us to make the most of our own experience, for the richest experiences come most surely to the mind which is prepared. I have deliberately refrained, however, from discussing reading and study as a means of enriching experience, partly because to do so would be to repeat what you have heard so many times before, and partly because if I should dwell at length on reading and study, I might obscure the importance of that kind of experience which I have been urging, namely, experience outside the academic world. We teachers already are too prone to substitute book knowledge for experience. At best, reading and study bring to us second-hand experience. Do not misunderstand me, I do not undervalue such experience. Much if not most of our best thought material must necessarily be second-hand. The experience of each of us, however inclusive and deep, is inevitably limited, and each of us would live within exceedingly narrow boundaries if he were confined to the area of his own individual contact with things and persons. It is only through reading that most of us can come in contact with great men and gain the information and ideas that come from great minds. The experience of meeting great minds through reading can immensely expand our very local experience, projecting it over wide areas, and by integrating our reading experience with that local experience give to us a deeper understanding. The importance of storing up thought material in this way cannot be over-estimated, but all this in a sense is wholly outside of my purpose in speaking to you. I am not now concerned with the usual process of learning and I can contribute almost nothing to a discussion of reading and study except perhaps this:

To get the greatest benefit from reading, as from any other experience, our minds should be prepared for it, that is they should be stored with as great a variety as possible of true images and correct concepts that have been made real to us through our own experience.

The teacher who holds himself aloof from the world and attempts to enrich his experience solely by reading and study will encounter serious difficulties. He is in danger of transferring to his own mind from the minds of others thought material which his limited experience in life does not permit him to make wholly his own. He is unable to appreciate much that he reads because he lacks the experience which would make it real to him. Reading is supposed to stimulate thinking, but it is too often a substitute for thinking. To read and to reason without adequate experience as a check is likely to lead to seemingly logical but actually fallacious conclusions. This is shown by much that has been and is being written in such fields as economics, sociology, philosophy, and religion,—and, may I add, as engineering and education.

We have in a sense a necessary circle of prerequisites. Reading and study are necessary to prepare the mind for the impressions that come from experience, but experience is necessary to prepare the mind for reading and study. For example, we need to read and study extensively to prepare ourselves for a trip around the world, but we need a trip around the world to prepare ourselves for this kind of reading and study. After such a trip we may re-read with added interest and appreciation, indeed we can hardly pick up a magazine or a book without becoming interested at once in something that pertains to places and people that we have visited and seen, or to other experiences that we had on our trip. We cannot then afford to neglect either element in this circle of prerequisites. Most of us appreciate, I think, the need of reading and study as a preparation for experience. We must appreciate as well the need of varied experience as a preparation to reading and study.

As I pass from this topic of reading and study, may I suggest that in seeking to enrich our experience by reading, we begin with that which interests us and gives us pleasure—a guiding principle already recommended for seeking experience in general. Many a man's interest in reading has been killed by his trying to read what conventional standards seem to require. In biography, for example, conventional standards require that we read the lives of certain outstanding men in history, but it may be better for us to begin with men who, because they are within the range of our own experience, interest and inspire us more. No one can prescribe for a man what he ought to read, for a man can read with appreciation only that for which his mind is prepared. We enjoy reading what

we really appreciate, and as experience adds to the extent and variety of our images and concepts, we appreciate and enjoy a greater variety in our reading. Thus enrichment of experience is the surest—I am tempted to say the *only*—approach to a genuine and independent understanding and appreciation of the best thought in literature.

CULTURE

The topic "Enrichment of Experience" may have led some of you to expect that I would speak about culture, but I have intentionally refrained from doing so. I should be open to justly severe criticism however, if I should fail to recognize culture as an important part of experience. But when one speaks of culture he should make clear just what he has in mind. No two of us, perhaps, have the same conception of what culture really is. As defined by Mathew Arnold, culture is "the acquainting ourselves with the best that has been known and said and thus with the history of the human spirit." According to this, culture is largely if not wholly the acquisition of knowledge. It may not be fair to Mathew Arnold to quote this definition apart from its context, but it is fair to say that this conception of culture as wholly and coldly *intellectual* is all too prevalent. We frequently assume that a certain type of knowledge to be obtained from so-called cultural courses is the essence of culture. Too often the result is merely a thin veneer that we erroneously call culture, which taken by itself may be essentially selfish and egotistical. It frequently develops into the self-conscious pose of the "highbrow," as provincial as it is amusing. Consequently "culture" is a word that is rapidly being discredited. If we are to save it from disrepute we must be careful to use it in its true meaning. Most of us, I think, associate with a man of culture not only mental cultivation and learning, but also refinement, good taste, good manners, and the ability to express himself with power and charm. We like to think of him as a gentleman, a man of good breeding, courtesy and kindliness. But such qualities as courtesy and kindliness are not primarily intellectual, for like all true instincts of a gentleman, they spring from the heart. How futile it is to expect culture in this sense to be gained merely from cultural studies if we lack the experience that enables us to interpret and appreciate. It takes well nigh a life time for culture to develop in all its fullness. In the truly cultivated mind there must be stored up images and concepts that are real because they have been gained by first-hand experiences—images and concepts that enable one to appreciate the true, the good, and the beautiful. To the thought material acquired by reading and study must be added thought material that comes from

experience and experience only. Culture in its narrow sense is no substitute for experience, culture in its true sense includes experience. In the last analysis, culture is rich, varied experience.

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In discussing the enrichment of experience in such detail and at such length as I have today, I may have seemed to claim too much for general experience. Surely some of the greatest thinkers in history were seemingly men of limited experience. Kant, for example, is said never to have been outside the town in which he lived. But, may I remind you, I have not been discussing rational knowledge or abstract thinking, nor have I had in mind greatness and genius. I have merely undertaken to consider the effect of a well rounded experience in the development of the teacher. Possibly I may seem to think that as compared with such experience there is little else of importance. I should regret leaving any such impression. I do not undervalue the necessity for complete mastery of the theory and practice of the engineering subject which we teach, or the importance of good teaching methods. I have taken all this for granted. I am conscious also of having omitted any adequate consideration of the necessary preparation for experience. As already stated, the richest experiences come most surely to the mind which is prepared. Education itself is an experience to prepare for experience. Neither have I ventured to consider how best to use experience as we acquire it—a discussion that would involve the whole art of thinking, to say nothing of human behaviour. No! My one topic has been sufficiently difficult. To undertake in a single lecture even to suggest the possibilities that lie in the enrichment of experience has taken about all the optimism and courage that I possess.

I would not have you think that I have singled out engineering teachers as men who need more than other men to enrich their experience. What I have said concerning the enrichment of experience applies to most men everywhere. But generally when a man fails to enrich his experience he and his friends are the principal losers, whereas when a teacher fails, his students are the principal losers. The implication, I think, is clear.

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In all of my discussion thus far I have been speaking as one teacher to another. When I began teaching nearly forty years ago I believed in the old motto "*Labor omnia vincit*"—work conquers all things. I thought that to be a successful teacher all that was necessary was to work hard, master my subject, acquire the best methods of teaching, and keep abreast of engineering practice. I have changed my mind. I see now that work does not conquer all

things and that to know ones subject, methods of teaching, and current practice is not enough. I regret that I did not realize this early in my career. I want you younger men to avoid such a mistake; to realize that it is easy to work hard and yet be absorbed in a routine so full of details and non-essentials that life is almost barren of rich experiences. I want you to be more certain than perhaps some of you are that to spend all of your spare time, including vacations, in work directly connected with engineering or education is *not* the best preparation for teaching. I wish that you would cultivate an irresistible desire to seize as many as possible of the daily opportunities for acquiring new images and concepts, and that at intervals you would break away from all of your regular work for some new and extended experience, so that you gradually but continually enrich your thought material and your lives. But all of this is from the point of view of a teacher. In closing may I speak briefly from the point of view of a father. It is from that point of view, perhaps, better than from any other that I can summarize what I have been trying to say to you.

The experience of having a son in college brings to a college teacher new concepts—strange ideas and beliefs bordering upon educational heresy. Somehow we do not seem to care whether a teacher knows a little more or a little less of his subject—we assume that he knows enough to teach his students. We even find that we do not get very excited about his teaching methods—we take for granted that they are reasonably good. The important question is: "What kind of a man is this teacher who is influencing my son during his impressionable age?" We should like to look into the mind of this teacher and see if he has stored there a great variety of worthwhile images and concepts that are very real to him because he has gained them from first-hand experience. We should like to see if, in addition to a knowledge of his subject and how to teach it, he has thought material so rich and abundant that it permeates all his thinking and affects his personal qualities to the everlasting benefit of his students. But we cannot look into this teacher's mind, and so we should like to do the next best thing. We should like to ask him a few important questions. He frequently examines our boy, now we are going to examine him. Here are some of our examination questions:

Does he mingle with men outside of his own profession, and welcome contact with all kinds of men?

Has he gained any first-hand understanding of social problems and governmental problems by actual service to his community—does he carry his fair share of civic burdens?

To what extent has he traveled?

What does he do for recreation—what are his hobbies?

Is he trying to substitute reading and book study for experience? Does his own experience prepare him for reading so that he can widen his horizon and expand his mind by meeting great minds in books? How and what does he read?

Is he seeking culture in a mere acquaintance with things cultural or is he gaining culture without conscious effort from rich and varied experience?

Is he seeking to enrich his experience merely for a purpose or because he has an eager curiosity and interest which compel him to make excursions into experience with a mental welcome to new images and concepts?

These are typical questions in our examination of the teacher. We would not put these questions directly to him, because we do not desire direct answers. We would merely engage him in random conversation. If his mind is stored with rich thought material it will be revealed, unconsciously, we hope, but none the less surely, provided we ourselves have the thought material that enables us to draw it out.

Here and there among engineering teachers, as among all college teachers, there is a mind of exceptional originality and power,—a mind destined for important research. A man with such a mind may make his greatest contribution by concentrating on his work, denying himself many of the richest experiences of life. But most of us are primarily teachers—just plain teachers. We shall render great service if we can be *good* teachers. To be a good teacher we do not need to be exceptionally great in any particular quality, but we do need to be well developed within the whole circumference of experience. Mr. Gano Dunn has said: "The type of man that makes the engineer, fundamentally, is not the type that makes the pure scientist or the research worker. There is something in the make up of the engineer that finds him classified towards that end of the scale described by Shakespeare as the man of 'full habit,' a type which you do not find in the laboratory." To paraphrase this statement of Mr. Dunn's: The type of man that makes the engineering teacher, fundamentally, is not the type that makes the pure scientist or research worker. There is something in the make-up of a good teacher that compels him constantly to seek the enrichment of experience so that through the passing years he gradually grows to the full stature of his potential power and influence.

THE OBJECTIVES OF COURSES IN DRAWING AND DESCRIPTIVE GEOMETRY *

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It probably can be safely said that there is no subject in a college curriculum whose objectives and aims and importance and value are so vaguely understood by educators in general as are those of the subject of graphics.

When Count Gaspard Monge introduced his new subject of Descriptive Geometry into the curriculum of the Ecole Polytechnique in 1795, after it had been held so long as a military secret, he probably emphasized to the committee on instruction its practical value in the graphical solution of problems which up to that time had been solved by long analytical methods or laborious empirical constructions, but we may be very sure that he well knew what a powerful subject it would be in training in constructive thinking.

He says in his text, abbreviating in translation, that descriptive geometry has two objects: the *first,* to give the methods of representing on a sheet of paper which has only two dimensions, the shape of a body which has three. The *second,* to recognize from an exact description the form of a body and all the truths about it.

But in his long introduction or "programme" Monge goes much farther in his description of the value of this new science. He attributes the dependence of France on foreign industry to its lack of appreciation of exactness, and prescribes the study of descriptive geometry by all the people as the remedy to make the nation independent, to exercise the intellectual faculties of a great people and contribute to the perfection of the human species. That this high estimate of the subject which he had developed so thoroughly had a great effect on national education in France is evidenced by the fact that from that time to the present descriptive geometry has held a most prominent place both in the secondary schools and the colleges. It is always classed as a branch of mathematics, and in the technical schools is carried much farther than was ever done in this country.

This is equally true of other European countries, as Switzerland, Germany and Sweden, where thorough courses in advanced de-

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scriptive geometry are given in all the engineering schools. (Without having counted them, I believe there have been more *descriptives* published in France in the last twenty years than in the United States.)

When brought to this country in 1816 by Colonel Crozet, descriptive geometry came as a military subject. In the first book on it written in English (1821) Crozet tells of its usefulness in machine design, bridge design, roads and canals, ship construction and fortifications, and at the same time recognizes its value in strengthening the imagination, as indicated by the following quotation:

"We are now possessed of new and fruitful methods, which are capable of being applied to all kinds of combinations that circumstances can require, or the mind conceive. We ought, therefore, from their application, to expect the greatest perfection in modern works; and this not only from the facility we acquire in translating our projects into *graphic language,* but still more from the habit which the simplicity of the processes in descriptive geometry gives us of conceiving the forms of bodies, and deducing from their ideal representation the most abstract truths of geometry. In fact, by studying this new science, the mind becomes accustomed to figure to itself lines and surfaces, arranged and combined in every possible manner. This action of the imagination increases its strength and its accuracy, so that it has been said, with truth, that descriptive geometry was the science of the engineer. The remarkable clearness of its operation, its peculiar character of evidence, the faculty which it gives of beholding mentally the moving representation of geometrical figures, cannot fail of being extremely useful in practical mechanics; as the perfection of machines depends principally upon the ease with which we conceive and combine their elements. . . ."

Charles Davies, who succeeded Crozet at West Point, has in his book *Elements of Descriptive Geometry,* published in 1826, a paragraph giving his idea of the importance of the subject:

"The study of the mathematics, whether considered as introductory to its sister science, mechanical philosophy, or as a salutary and invigorating exercise of the mind, is equally worthy of attention. The useful and important results to which it leads, mutual dependence of its parts, and the concise and satisfactory reasoning in the development of its principles, recommend this study, as well to the practical man, who learns only what he can successfully apply, as to the lover of science, who explores all its departments in search of new facts and interesting truths."

His next paragraph, which was quoted by Professor Higbee last year in his *History of Descriptive Geometry,* is of interest in connection with this study of objectives.

"The subject of descriptive geometry, which is treated of in these elements, has not, as yet, been considered in this country as a necessary part either of polite or practical education. It has been taught in the Military Academy since 1817, but has not found its way into other seminaries with a rapidity at all proportionate to its usefulness. The progress of science, like that of truth, is always slow; yet it compensates for its want of velocity in the steadiness of its advancement and the certainty of its success. In France, descriptive geometry is an important element of a scientific education; it is taught in most of the public schools, and is considered indispensable to the architect and engineer. Its intimate connexion with civil engineering and architecture, and the facilities which it affords in all graphic operations, render its acquisition desirable to those who devote themselves to these pursuits."

Church, who succeeded Davies, evidently saw no necessity for writing an argument for a subject required and well established in the curriculum. As you will recall, he merely says in his Preface, in the accurate language that would be expected from a military engineer:

"Without any effort to enlarge or originate, the author has striven to give, with a natural arrangement and in clear and concise language, the elementary principles and propositions of this branch of science, of so much interest to the mathematical student, and so necessary to both the civil and military engineer."

And the opening sentence of his book gives the definition, that perhaps has not been improved upon:

"Descriptive geometry is that branch of Mathematics which has for its object the explanation of the methods of representing by drawings:
First. All geometrical magnitudes.
Second. The solution of problems relating to these magnitudes in space."

Which of course shows descriptive geometry to be the theoretical basis upon which all of our drawing is built.

The quotations from these early books indicate the objectives in the minds of their pioneer authors. It is not necessary to go much further in quoting later authors, either in the barren period after Church or the prolific period of the present century, but one from each of these periods may be mentioned. Perhaps the most condensed definition is in Waldo's abbreviated manual of 1887—"Descriptive geometry gives power to express conceptions and to solve problems in the constructive arts; it also effectively disciplines the geometrical imagination."

Colonel Miller has a vigorous opening in the preface of his little book of 1911—

"Believing that no one study plays a larger part than descriptive geometry in the shaping of the student's mind into the analytic thinking machine necessary to success in any engineering profession, the author has outlined and written the text with this as its chief aim."

Most of the present-day authors in their prefaces emphasize the practical value of the subject. These introductions no doubt tend to give the prospective student a sense of the importance of the subject he is about to study, and perhaps to defend its position in the curriculum. And, indeed, in these days of destructive criticism, a subject must be defended, and be capable of defense, against iconoclastic attacks, and must have more than tradition and precedent to enable it to hold its position.

As technical schools were established, one after another, in this country, their courses in descriptive geometry and drawing were modeled after the French experience and methods. In drawing, skill in execution was the chief objective. This was in the day of the fine line drawing, made to look like a copperplate engraving. Reproduced examples seen by the students were actual engravings either on copper plate or on lithographic stone. Shade lines were universally used and much time was spent in surface shading both in line and in water color. Whole courses were given in laying water color washes, either by the French method of overlaying or by the faster American method of softened tints. Drawings were duplicated by pricking through and later by tracing. With the invention of blueprinting all the fine line requirements and colored sections and shading became obsolete, and these courses were gradually modified or dropped. This change in drawing practice eliminated the necessity for long training for skill in difficult execution, and gave a justifiable reason for reducing the number of hours required. The time thus saved was eagerly taken by other engineering departments to keep up with the advance in engineering practice, and thus the precedent was started of cutting the drawing department's time whenever a new course was added. According to Dr. C. R. Mann's report, the total time allotted to drawing at the Massachusetts Institute of Technology was reduced between 1867 and 1914 from 49 hours to 17 hours. This reduction has continued in the case of some schools to an unjustified minimum.

The limited time allowed for the subject places a correspondingly greater responsibility on the drawing teachers to know their objectives and work to them with no lost motion.

Each year large numbers of high school and preparatory school graduates enter our universities and technical schools to prepare for the various engineering professions. Curricula have been arranged in the attempt to use to the best advantage the four years

of time allotted to undergraduate courses, and the problem of the drawing department is to use its portion of this time to train these young men in knowledge and habits of thought that will serve them in the best way in their life work.

As drawing and descriptive geometry are so closely allied, and in this country are almost universally taught in the same department, they have in this topic been combined as one subject.

In classifying the objectives toward which a drawing department should work, they may be placed in two general divisions, practical and cultural (so-called), although in teaching the subjects there is a constant overlapping, as the practical side well taught is cultural, and the cultural aims are motivated by practical reference.

By *practical* we may be considered to mean the things that an engineer must know in the practice of his profession. He must in the first place be able to make an accurate graphic representation of a structure. An engineer who could not read and write in the graphic language would be classed as professionally illiterate. Monge's two objects then still stand, just as important as when he proposed them in 1795, and we recognize orthographic projection as the foundation of all shape description. But there are degrees in proficiency in language. Although handicapped, a man can get through life with a limited vocabulary and faulty grammar, and some engineers have managed to practice their profession with a comparatively meager knowledge of the graphic language; but the engineer who can handle it fluently has a great advantage. Even if his penmanship, his execution, is poor, the ability to read a drawing accurately and quickly is of great importance. *One of the dangers in teaching this language is that the student may learn to write better than to read.* Training in reading drawings should be given constant attention.

From the practical point of view size description is as important as shape description, although it is perhaps difficult to make the student appreciate that fact. More time than formerly is now being given to the study of dimensioning, with the result that the student not only learns to dimension a drawing properly but he begins early in his course to get an elementary knowledge of different methods of shop production.

Another practical object is the teaching of the value and use of symbols, the idioms and abbreviations of the language. Drawing is often called the universal language, but it still has a good many dialects, although standardization is gradually bringing them together.

The analogy between drawing and written language has been made very often, but the comparison may sometimes give the impression that drawing is a sort of elementary or incomplete form of

communication. On the contrary, drawing is the one language of *exact* expression. Words are only symbols of mental pictures varying with every reader, and not only are they inadequate to describe constructions, but word combinations are so inaccurate and imperfect that the principal business of at least one entire profession, that of law, is to prevent and correct word misinterpretations. We may be thankful that the graphic language has invariable content and is interpretable without the services of another profession.

In the making of drawings there arises the question of the relative importance of the objective of skill. We all agree that the use of the instruments is only incidental in the subject of graphics, although there are too many people who think that teaching drawing is only teaching how to draw. In the early days students became skilful draftsmen, and many of them entered the profession of engineering via the drafting room. While more at the present time choose to go into management, administration and production, or even into sales, rather than into design, training in accuracy and speed is still one of the important secondary objectives. With the professional draftsman the manipulation of instruments becomes habit, leaving his brain free to work on the design. A designer at work on his board, sketching with facile pencil, changing, discarding, improving—thinking on paper—with no conscious thought of the tools with which he is working, furnishes an example of the fluent use of the graphic language. Even with the limited time available I believe it is possible to teach the use of instruments in such a way as to get a good start toward making ordinary drafting operations automatic, with the motor impulses coming from the sub-cortical regions.

Many a student gets his first idea of the meaning of accuracy when he starts in elementary drawing. Continued insistence on accurate execution must eventually improve accuracy of thought, and incidentally train in neatness. Commercially, accuracy is worth very little without the accompaniment of speed, the two together forming skill. As with any other operation requiring coordination there is a wide difference in ability. Students to whom skill comes easily often find subsequent graphical work attractive and enter their profession through the drafting room. Training in skill could be listed as a cultural objective as well as a practical one, since this skill may form the basis of ideals which will be carried over into other skills of manipulation.

The real training in accuracy of thought, however, comes from the subject matter of graphics rather than from careful execution. Drawing and descriptive geometry are exceptional educational subjects for strengthening the power and habit of exact thinking, one

of the most difficult of all habits to fix. There is, perhaps, no other subject in the curriculum so well adapted as is descriptive geometry for training in analytical and synthetical thought, and certainly there is no other subject to compare with it in training the constructive imagination and power of visualization. Descriptive geometry lays a heavy tribute on abstract intelligence.

Developing the ability to think in three dimensions, to visualize clearly in space, a requirement so necessary to the engineer, begins with simple objects in the elementary drawing course, continues with more complicated forms and progresses to combinations of abstract lines, planes and higher surfaces, somewhere along which progress the limit of the ordinary student's imagery, visual or tactual, is usually reached. For the exceptional man, training up to this point may be the means of unfolding a hitherto unknown power of constructive thinking, and enable him to extend it further to the relations of moving parts and invisible currents, even up to the development of genius. The great inventor is a man with an extraordinary power of creative imagination. The words of Benjamin Lamme on the medal of this Society come to mind, "The engineer views hopefully the hitherto unattainable." He views it with the hope and assurance of a trained mind, whose first exercise in logical thinking from the known to the unknown probably came in his college course in descriptive geometry.

Someone has said that it is "the power and habit of observing accurately that marks one of the fundamental differences between the incapable man and the man of power." In drawing there is a fine opportunity to strengthen the ability for accurate observation. Most of the subjects studied train the memory in retaining knowledge, but drawing trains in visual memory for form and proportion.

With these educational objects of developing the constructive imagination, visualizing in space, systematic and logical thinking, accurate observation, and habits of accuracy, neatness and skill, the cultural side of the work of a department of drawing becomes a tremendously important factor in the training of the future engineer, and when to these are added the practical aims included in the science of drawing, the knowledge and skill required in making engineering drawings, the ability to think on paper and to solve problems graphically, the potentialities in these subjects of our topic, it would seem, cannot be equaled by any other fundamental subject in the curricula of engineering education.

The methodology of drawing is complicated and difficult, although it would seem such an easy subject to teach. This is not only on account of the combination of objectives but also because of the great variation in the power of constructive imagination to be found in a group of students having approximately the same meas-

ure of mental capacity. Some have strong powers of visualization, others almost none. In the abstract mathematical sciences requiring pure reasoning ability, imagination is not a necessary aid, it might even sometimes be almost a detriment. Galton, you will remember, in his famous inquiry found a majority of his "men of science" to be devoid of mental imagery. But the engineer, whose profession is to invent, and design, and create form out of matter, must have it, and then must be able to record his ideas in a technical language whose style requirement is perfect clearness.

To develop this mental power in all the members of a class of so widely varying rudimentary ability and carry each one as far as his capacity allows, keeping the upper half spurred to higher endeavor and the lower half encouraged and interested, requires a high order of teaching.

Drawing is not a side line to be carried by an instructor of physics or chemistry. To delegate its direction to the inexperienced or immature is a crime against the student and a detriment to the engineering profession. It should be taught by a specialist trained in knowledge and skill, with a background of drawing board experience and a teaching instinct, who appreciates both the importance and the difficulty of his work and accepts with an earnest enthusiasm the responsibility of training the young minds instrusted to him in a subject of such indispensable value that without it modern engineering could not exist.

The objective of the present session is to analyze and evaluate the aims of this subject and find how best to attain them.

NEW MEMBERS

ADAMS, THOMAS O., Associate Professor of Civil Engineering, University of Utah, Salt Lake City, Utah. R. H. Suttie, H. P. Hammond.

BURGMAN, BASILE D., Assistant Professor of Structural Engineering, Moscow Technical Institute, Moscow, Russia. R. H. Suttie, H. P. Hammond.

DRUMMOND, GARRETT B., Assistant Professor of Mathematics, Oklahoma A. and M. College, Stillwater, Okla. L. L. Patterson, G. G. Gladney.

FISKE, DAVID L., Secretary, The American Society of Refrigerating Engineers, 37 West 39th St., New York City. R. L. Sackett, A. J. Wood.

GOODRICH, EDWIN A., Instructor in Civil Engineering, Lafayette College, Easton, Pa. Geo. F. Roehrig, Joe B. Butler.

HOLLAND, UBERT C., Instructor in Mechanical Engineering, University of Pennsylvania, Philadelphia, Pa. H. C. Berry, John A. Prior.

JONES, WALTER B., Research Professor of Education, University of Pittsburgh, Pittsburgh, Pa. F. L. Bishop, Nell McKenry.

MATHEWS, RALPH T., Instructor in Mechanical Engineering, Duke University Durham, N. Car. Walter E. Farnham, Arthur W. Leighton.

PLUMMER, FRED L., Assistant Professor of Civil Engineering, Case School of Applied Science, Cleveland, Ohio. H. P. Hammond, H. S. Carter.

SCHWARTZ, FRANK L., Instructor in Physical Elements of Engineering, Pratt Institute, Brooklyn, N. Y. F. L. Bishop, Nell McKenry.

SMITH, W. SHERMAN, Assistant Professor of Civil Engineering, University of the City of Toledo, Toledo, Ohio. John N. Eckle, Joe B. Butler.

TRACY, STEPHEN J., Instructor in Mechanical Engineering, University of Pittsburgh, Pittsburgh, Pa. F. L. Bishop, Nell McKenry.

REPORT OF SOCIETY DELEGATES TO THE WORLD ENGINEERING CONGRESS, TOKYO, JAPAN

August 6, 1930.

SOCIETY FOR THE PROMOTION OF ENGINEERING EDUCATION,
University of Pittsburgh,
Pittsburgh, Pa.

Attention: Professor F. L. Bishop, Secretary.

Gentlemen: President Kimball of the Society for the Promotion of Engineering Education, appointed the undersigned delegates to represent this organization at the World Engineering Congress held in Tokio.

We were all so fortunate as to secure accomodations on the official steamers "President Jackson or "Korea Maru" sailing from San Francisco on October 10, 1929, which carried the majority of the American delegates to the Congress. Besides being delegates from the Society for the Promotion of Engineering Education, each of us was also a representative of other educational institutions, engineering societies or scientific societies.

Besides being under the direction and control of the Japanese Engineering Societies, the World Engineering Congress and its associate, the World Power Conference, were made official functions of the Japanese Government and the delegates were shown great hospitality and kindness. The Americans were particularly singled out for hospitality, although this was not done to the injury of the delegates from other countries who came from all the important nations of the world.

Your representatives were called upon to preside at one or more sectional sessions of the Congress and were called upon for various official Congress duties.

The Congress was a very dignified affair with delegates from many of the greatest educational institutions of the world in addition to the delegates from governments and engineering societies.

Sincerely yours,

P. M. LINCOLN,
JOSEPH W. ROE,
DUGALD C. JACKSON.

BOOK REVIEWS

Sewerage and Sewage Disposal. METCALF AND EDDY. McGraw-Hill Publishing Co. 743 pages. Second edition.

The second edition of this well-known textbook has been materially enlarged and rearranged. The usefulness of the work from the engineer's viewpoint with the many charts, tables and detailed drawings, is unimpaired. The enlargement has been along the lines of basic principles of hydraulics, sewage and sludge treatment.

The omission of the table of the definition of terms would appear of doubtful wisdom but is comparatively unimportant. The addition of a liberal assortment of problems at the end of nearly every chapter is an outstanding improvement from the teacher's view point.

The chapter "Hydraulics of Sewers" has been rewritten with comprehensive mathematical analyses of the various phases of hydraulics that pertain to sewerage systems.

The treatment of the design of separate and storm sewers is much more complete and an entire chapter is devoted to it.

A chapter "Loads on Sewers" has been added. This chapter contains the results of the experimental and theoretical investigations of Marston, Anderson, Terzaghi and Mohr on earth pressures as applied to sewers. The selection of the shape of sewer section is considered in relation to construction, available space, and physical properties of sewers in an appropriate chapter on "Pipe and Masonry Sewers."

The chapter "Characteristics and Behavior of Sewage" (Chemical and Biological) has been improved by discussions of the meanings and relative values of chemical and biological determinations. This chapter is especially valuable to the student or engineer whose chemical training has been limited. The theory of Hydrogen-ion concentration is clearly summarized. Much valuable material has been added to the chapter "Disposal by Dilution," such as the Legal Aspects of Sewage Disposal, Oxygen Balance and Oxygen Sag, and the discussion of the stages of self-purification is more complete.

A chapter "Principles of Sewage Treatment" is added. This is of special interest to the sanitarian. It is an exposition of Hazen's Theory and Stoke's Law on Sedimentation and the chemical reactions of flocculation, sludge digestion and disinfection. Oxidation, filtration and activated sludge treatment is also explained.

The treatment of sewage filters is clarified by grouping the general principles of all filters in one chapter. This saves the repetition of separate discussions of each type in different chapters.

Summarizing, the work is notable as the result of the coördinated efforts of a highly reputable group of engineers assisted by engineering teachers drawing freely from outside sources of information. The first edition was presented from an engineer's point of view. The revised edition is much better suited to teaching purposes in that the arrangement of the material in the chapters causes a more logical sequence in the presentation of the basic principles, many additional and valuable fundamental principles are presented, and a much more liberal assortment of problems at the end of nearly every chapter greatly increases the value of the book for teaching purposes.

teaching purposes.

L. W. McI.

Applied Mechanics. ALFRED P. POORMAN, A.B., C.E. 3d edition. McGraw Hill Book Company. 297 pages, 17 chapters.

This 3d edition of "Applied Mechanics" still maintains the high standards established by the two previous editions.

The text affords an excellent opportunity for the student to display plenty of common sense, the power to visualize and the ability to think clearly, especially in that part on statics where formulae are few and far between.

There is a wealth of good problems and examples which bring out the fundamental principles and also plenty that test the ability of the best student.

By supplying answers to all problems it affords the student an opportunity of checking his result with that supplied by the author. By doing so the student generally discovers his error, whether in thought or execution, thereby saving valuable classroom time.

The introduction of the principles of work and energy in the early chapters on kinetics is an added feature of this edition.

The text is admirably suited to a five semester credit course, although with certain omissions may be used equally well in an abbreviated course.

R. F. E.

COLLEGE NOTES

University of Southern California.—Nathan C. Clark has been appointed instructor in electrical engineering in the College of Engineering of the University of Southern California.

Mr. Clark will assist in the general courses in electrical engineering and will have charge, with Professor Philip S. Biegler, head of the department, of the development of high frequency and radio work.

Stevens Institute of Technology.—The curriculum of Stevens Institute of Technology for the academic year 1930–1931 will include for the first time in the sixty year history of the college courses for graduate students. Stevens has heretofore offered a general unspecialized course in engineering and has given only the undergraduate degree in course. Since the inauguration of President Harvey N. Davis a Faculty Committee has been investigating the field of graduate instruction. Following the recommendation of this committee the Trustees and Faculty have approved a program of graduate courses leading to the degree of Master of Science.

Graduate instruction is given during the day in the fields of Electrical, Mechanical and Civil Engineering and in Business Administration. Research projects in the Properties of Steam, Smoke Abatement and the measurement of Engineering Aptitudes are now in progress.